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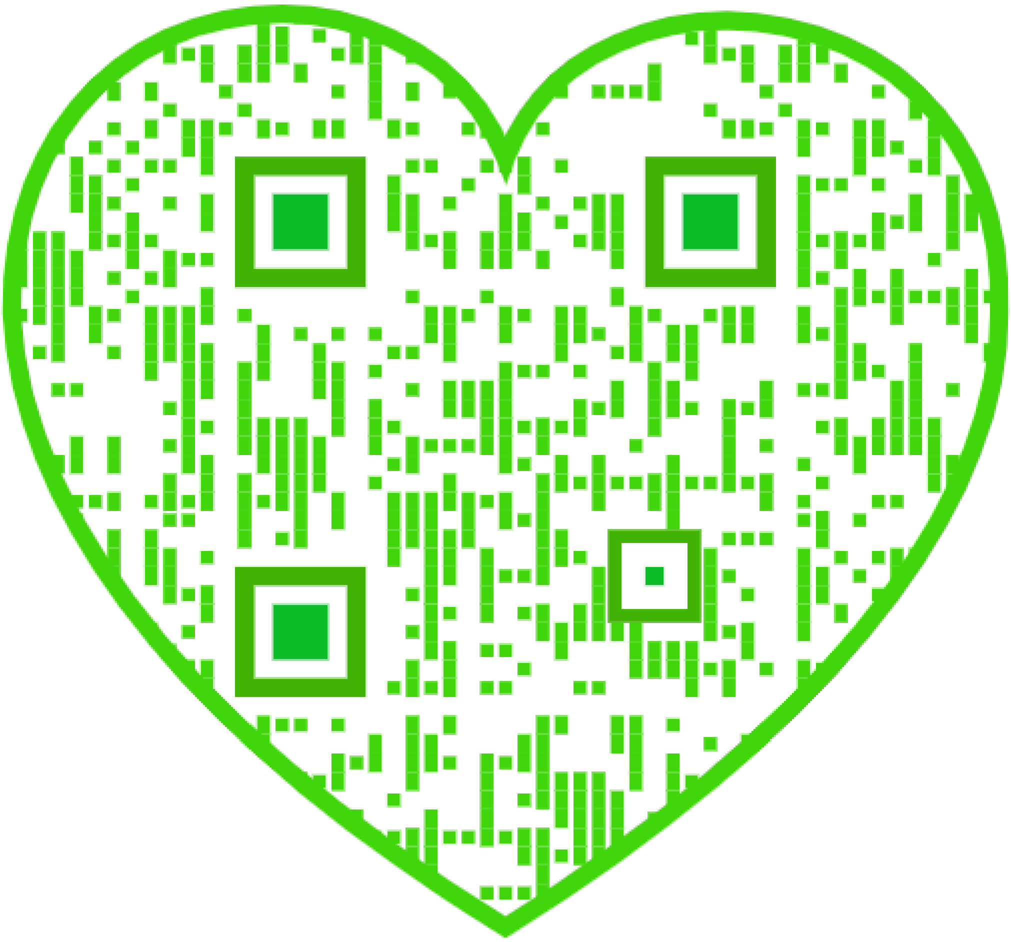

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Cold War Patrol: A Tu-142 Bear-F Mod III and a P-3C of VP-45 meet over the ocean, 1986. *US Navy*

Maritime Patrol Aircraft

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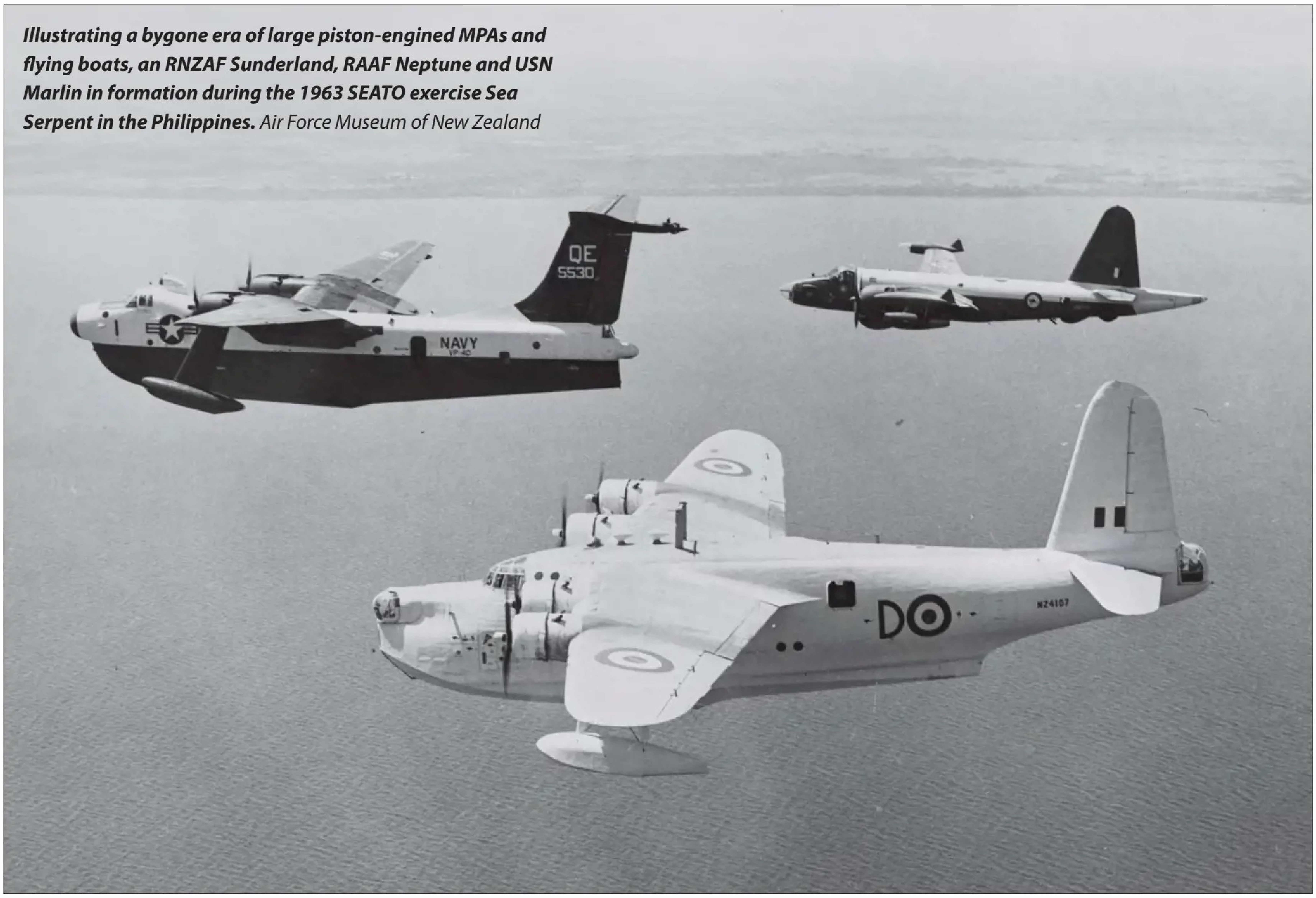
Cover Photo: Bundeswehr/ Sascha Linkemeyer



Illustrating a bygone era of large piston-engined MPAs and flying boats, an RNZAF Sunderland, RAAF Neptune and USN Marlin in formation during the 1963 SEATO exercise Sea Serpent in the Philippines. *Air Force Museum of New Zealand*

Ping!

Sub-hunters and maritime patrol aircraft are diverse group, ranging from coastal patrollers to missile-armed jets, with amphibians still hanging on in Japan.

Aviation Archive's Issue 78 covers the full range of fixed-wing MPAs, from modified wartime bombers and bespoke carrier-based aircraft to converted airliners and business jets.

Anti-submarine warfare and maritime patrol is one of those areas of military science caked in acronyms: both the mission types: ASW, SAR, HADR; and the mission equipment: LOFAR, ATOS, FITS and many more. I hope this issue helps the reader sort their MPA from their MSA and their P2V-7 from their P-72A.

Patrol aircraft are secretive beasts. I have been aboard a few, but never in flight and cameras are usually forbidden. They largely do their work offshore, unseen or unheard by all except passing ships and skulking submarines. More recently, their sophisticated sensors have been employed in land conflicts such as Afghanistan, providing ground commanders with real-time video and other intelligence. Such multi-role capabilities are sure to expand on future platforms and systems.

Thanks are due to David Willis for writing the entries for the Shackleton, Gannet and Seamew.

Profiles except the Privateer and Neptune are by Rolando Ugolini. This issue welcomes a new designer, Paul Sander of Panda Media. Uncredited images in this edition come from the Key Archive and others are only individually credited if sourced from elsewhere.

Jim Winchester

Aviation Archive Series

Maritime Patrol Aircraft

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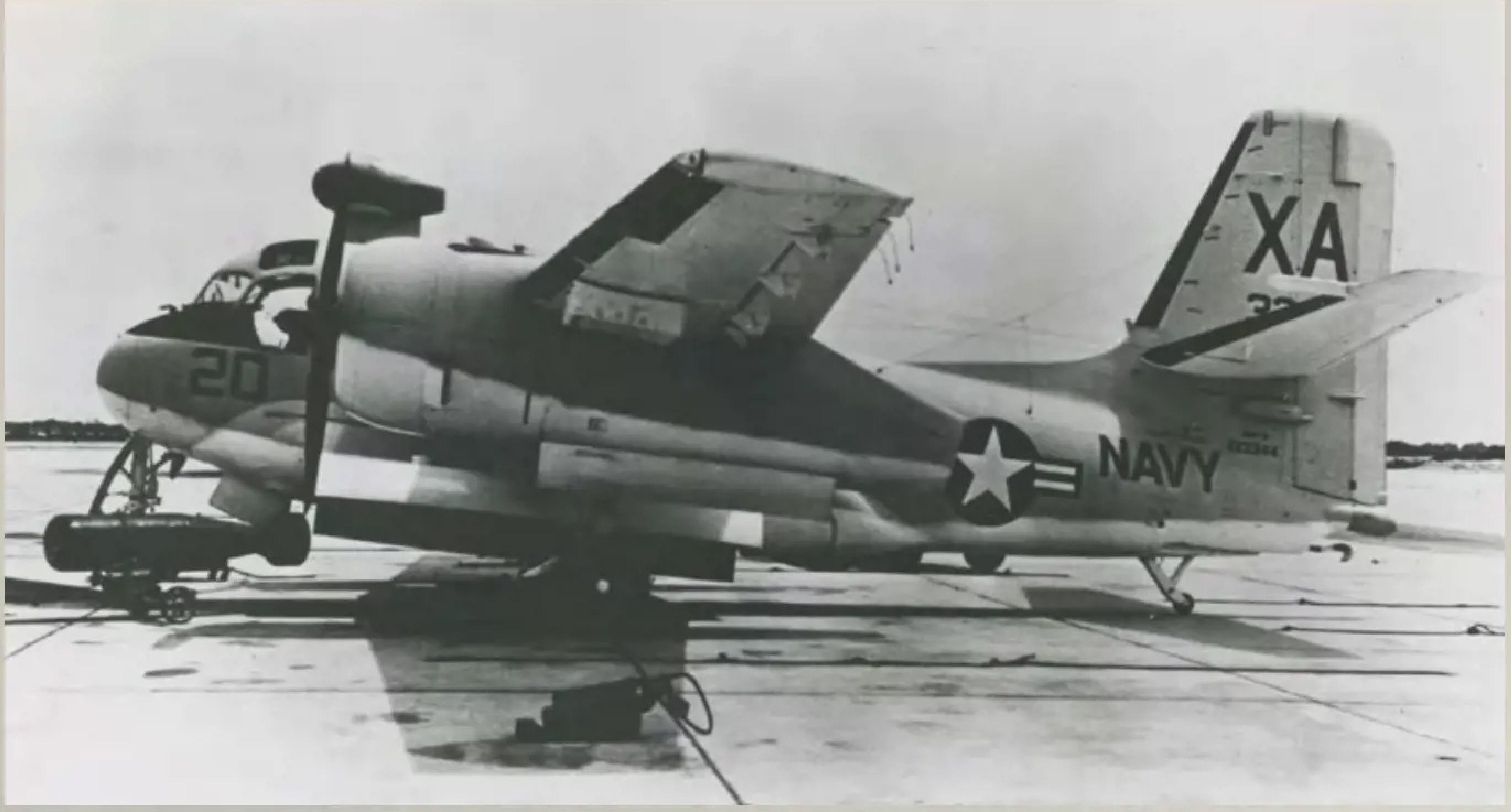
Anti-Submarine Warfare

Find, Fix, Finish

Anti-Submarine Warfare (ASW) as conducted by fixed-wing aircraft is a mixture of science, technology and sometimes luck. Success is often down to the skill and experience of aircrew systems operators to locate, track and, if necessary, destroy hostile submarines.

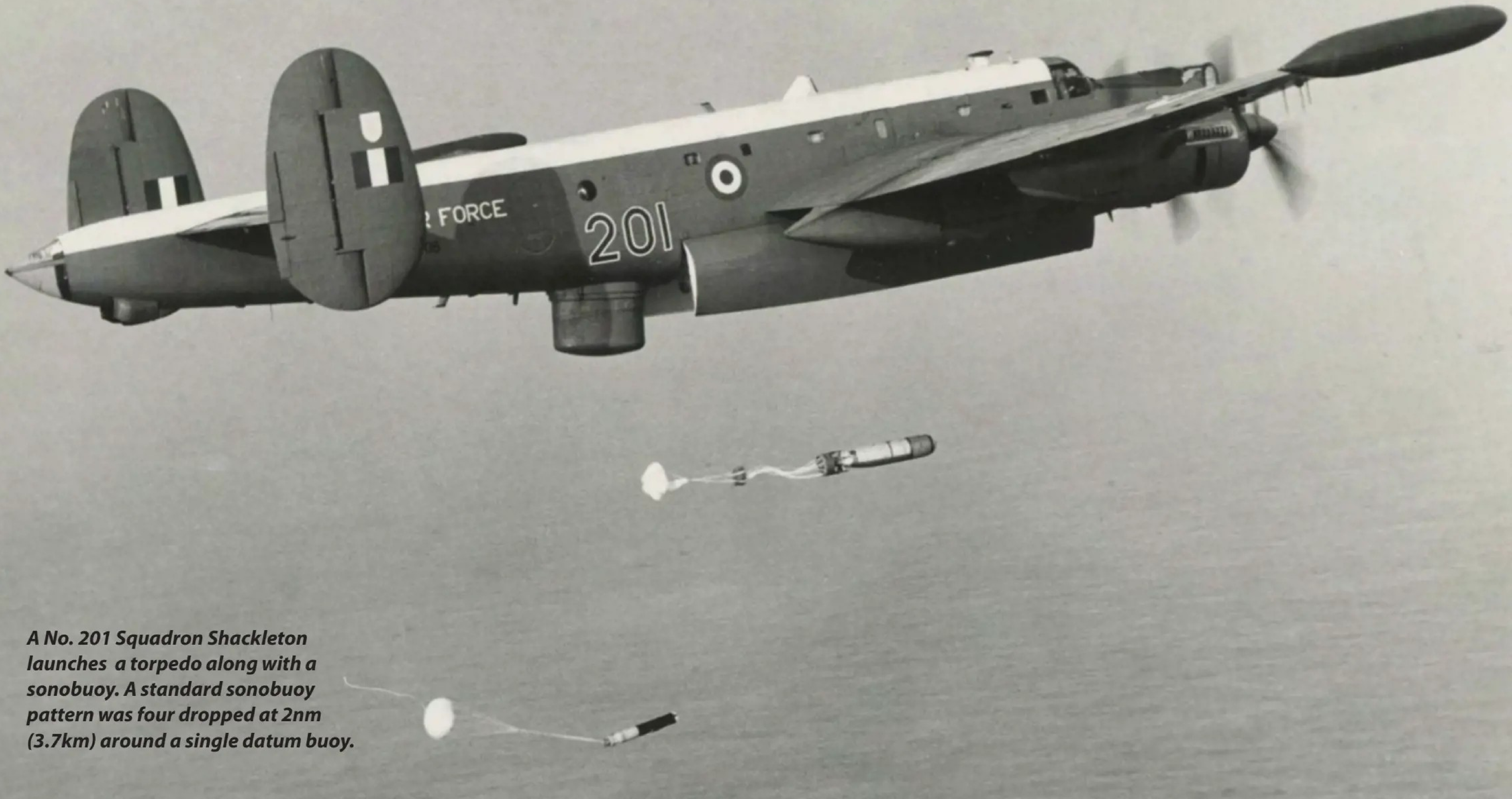
No submarine has been sunk by a patrol aircraft since World War Two, although many have been forced to surface. The very presence of an MPA can render a sub ineffective in its mission. Technological developments in submarine detection and ASW weapons have been matched by those of the submarines themselves. Nuclear-powered submarines (SSNs) can dive deeper and stay submerged almost indefinitely, but their reactor cooling systems generate more noise than diesel-electric subs (SSKs). Acoustic tiles and non-ferrous metals can reduce their sound and magnetic signatures, which is important because by using the principle that large metal objects disturb the local magnetic field and this disturbance can be located, Magnetic Anomaly Detection (MAD) has been a primary airborne ASW tool since the 1940s.



If you absolutely, positively have to kill a submarine, nuclear weapons are your last resort. The innocuous-looking weapon beside this S-2 Tracker is a Mk. 90 'Betty' depth bomb with a yield of 2-90 kilotons.

Only recently has MAD equipment been omitted from the P-8A Poseidon, although it has been supplied with India's P-8I version. MAD requires low-level flight over a precise track and can be affected by the presence of wrecks and seabed magnetic variations. It is good for narrowing the search area rather than exact location of the target.

Some Soviet nuclear submarines were built with hulls of non-ferrous titanium in part to avoid detection. MAD sensors are usually mounted on long tail booms to reduce the influence of the



A No. 201 Squadron Shackleton launches a torpedo along with a sonobuoy. A standard sonobuoy pattern was four dropped at 2nm (3.7km) around a single datum buoy.

A depth charge dropped by a JMSDF P-3C explodes while another Orion runs in for an attack during a 2015 demonstration.
Jim Winchester

aircraft's metallic structure and interference from its electronics. It proved impossible to integrate the technology in the Avro Shackleton because of its electromagnetic 'noise'.

The sophisticated magnetometers in newer MAD systems require liquid nitrogen cooling but are sensitive enough to detect undersea mines.

The primary submarine detection method has been acoustic, listening to the noises a sub's propulsion system, equipment and even crew activities make, which can travel long distances underwater. In use since World War Two, sonobuoys are cylindrical devices dropped in a pattern by an MPA to detect submarines either actively, by sending and receiving a pulse that is reflected back to the buoy then transmitted to the aircraft, or passively, by listening for low frequency sounds produced by the submarine.

Many western MPAs were fitted with Julie/Jezebel equipment. Julie was an active sonobuoy system using the Explosive Echo Ranging (EER) technique, where a small explosive, called a Practice Depth Charge (PDC) was dropped in the water and the reflected echo received by hydrophones on the buoys and then transmitted to the operator. This had the disadvantage of alerting the submarine to an active search. Julie was supplanted by active sonobuoys that generated their own 'ping' similar to a ship's sonar, negating the requirement to drop PDCs

Jezebel, more formally called the Low Frequency Analyzer and Recorder (LOFAR) system, was a passive acoustic recorder used to analyze the sound signature of submerged submarines in order to detect them. The sounds detected by sonobuoy were transmitted to the aircraft via one of 31 VHF radio channels assigned to each sonobuoy. Jezebel computed the relative strengths of the submarine sounds and then displayed the frequencies of the sounds that uniquely identified or 'fingerprinted' each class of submarine.

Untold numbers of sonobuoys have been deployed over the decades. Operational ones are expensive; a pattern of 15 used for a Julie search was said to cost as much as a Cadillac car, and Soviet 1970s sonobuoys were each equivalent value to a colour television set. Typically, after about four hours a plug on the buoy dissolves, causing it to sink, making it theoretically recoverable in a training situation.

Modern directional sonobuoys incorporate GPS receivers, allowing them to be very accurately placed from higher altitudes with compensation made for drift.

Dipping sonars are normally the preserve of helicopters, but they could also be used by flying boats. The modus operandi of the Shinmeiwa PS-1, for example, was to make frequent landings in the area of interest, operating its sonar then flying a short distance to another location to dip it again.

From the 1950s, NATO submarine location in the Atlantic and Pacific was aided by the SOSUS (Sound Surveillance System) network of sensors distributed on the seabed, later renamed Integrated Undersea Surveillance System (IUSS). The system's acoustic sensors could give an approximate fix for a transiting submarine, generating an area of probability to dispatch an ASW aircraft into. Once the aircraft had established an accurate fix, it could track the submarine until relieved, or attack if necessary.

Echo location and magnetic influence are not the only ways of finding submarines. Conventional submarines produce a trail of invisible exhaust gases downwind when running on their diesel engines. A device called an Exhaust Trail Indicator (ETI), also known as the AN/ASR-3 'Sniffer' could help an aircraft close in to visual or radar range, or drop a datum marker for a sonobuoy pattern. It was used on the P-2, S-2, early P-3s, Lancasters and Shackletons. In coastal areas and where there was heavy shipping traffic, false positives were high, and it was gradually abandoned.

Finding a submarine in wartime is no use without effective weapons to destroy it.

An RNZAF P-3K2 drops a Mk. 46 torpedo on an instrumented range near Hawaii during the RIMPAC exercise in 2016. *US Navy*

Homing torpedoes are the prime ASW weapon. Passive models such as the Mk. 30 homed on radiated noise from a submarine. The first active homing US torpedo was the Mk. 32, in use from 1950-55. It and subsequent torpedoes transmit a sonar signal, which is reflected from the target, Replacing the 1960s-designed, Mk 46, the Mk 54 'Mako' entered service in 2004 and is the standard air-launched torpedo in use by the US and many allies. Britain's Sting Ray dates from the 1980s and was used by the Nimrod MR.2, and the Mod. 1 version is being integrated on the Poseidon MRA.1.

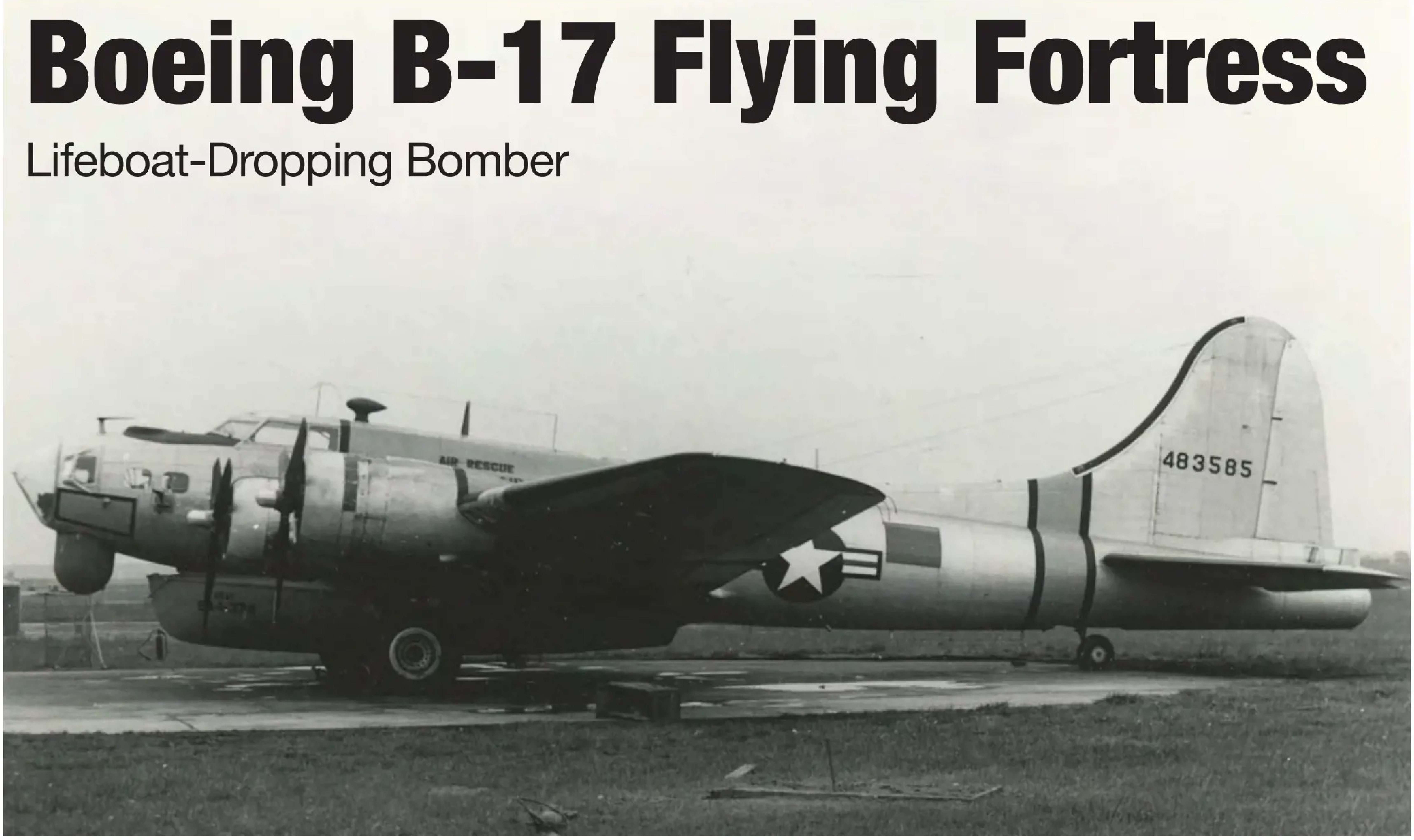
The P-8 has been designed to perform its search mission at higher altitudes than its predecessors, but this complicates things when it comes to the attack phase as considerable time is needed to descend from surveillance altitudes of 30,000ft (9,000m) to torpedo-dropping height of 300-1,000ft (90 -300m). As such, Lockheed Martin has developed the LongShot wing adaptor kit to allow high-altitude Mk. 54 torpedo drops from stand-off ranges, although this is not yet operational.

Conventional depth charges have to detonate close to a submarine to sink or disable it, requiring high accuracy, which is hard to achieve with traditional cylindrical weapons dropped from aircraft. These days depth charges are often just bombs with a retarding tail and a depth setting on the fuse. Nuclear depth bombs (NDBs) offered a higher probability than homing torpedoes of destroying modern high-speed, deep-diving Soviet submarines, but are no longer fielded. Examples included the US Mk. 90 'Betty', Mk. 101 'Lulu' and the B57, which was used by P-3s, S-3s and Nimrods until the end of the Cold War. Nimrods could also carry the British WE.177A NDB.

A Sting Ray Mod 1 torpedo, now becoming operational on the RAF's Poseidon MRA.1s. The weapon has a 99lb (45kg) warhead and a range of about 5 miles (8km).
Cpl Sian Stephens, RAF Crown Copyright

Boeing B-17 Flying Fortress

Lifeboat-Dropping Bomber



Above: ***This Douglas-built B-17H displays its radar and lifeboat. Operated by USAF rescue squadrons at McDill AFB, Florida and Wiesbaden, Germany, it was struck off charge in November 1951.*** *Jim Winchester collection*

The famous strategic bomber served also served in the patrol and rescue roles with the US Army, Air Force, Navy and Coast Guard.

The Boeing Model 299, prototype of the B-17 Flying Fortress, flew on 28 July 1935. Over the next ten years it evolved into a heavily armed strategic bomber with the USAAF and an anti-submarine patroller with the RAF. Only a few of Coastal Command's Fortress Mk. IIs and IIIs made it into the post-war era, with No. 251 Squadron disbanding in Iceland in October 1945 and No. 521 at Chivenor, Devon in April 1946.

The USAAF's 8th Air Force fitted the Higgins A-1 lifeboat with a capacity of 12 people to the B-17H for rescues of downed bomber crews in the English Channel. From 1945 some served in the Far East to support B-29 operations over Japan. Most of the defensive guns were retained. With many surplus 'Forts', the American services still had uses for a long-range four-engined aircraft able to carry a substantial load including search equipment. Fitted with H2X radar in the former chin turret position under the nose, the B-17H became the SB-17G in 1948. Armament was usually deleted, but during the Korean War, when B-17s again provided SAR cover for B-29s, this time from Japan, cheek, waist and tail guns were often refitted.

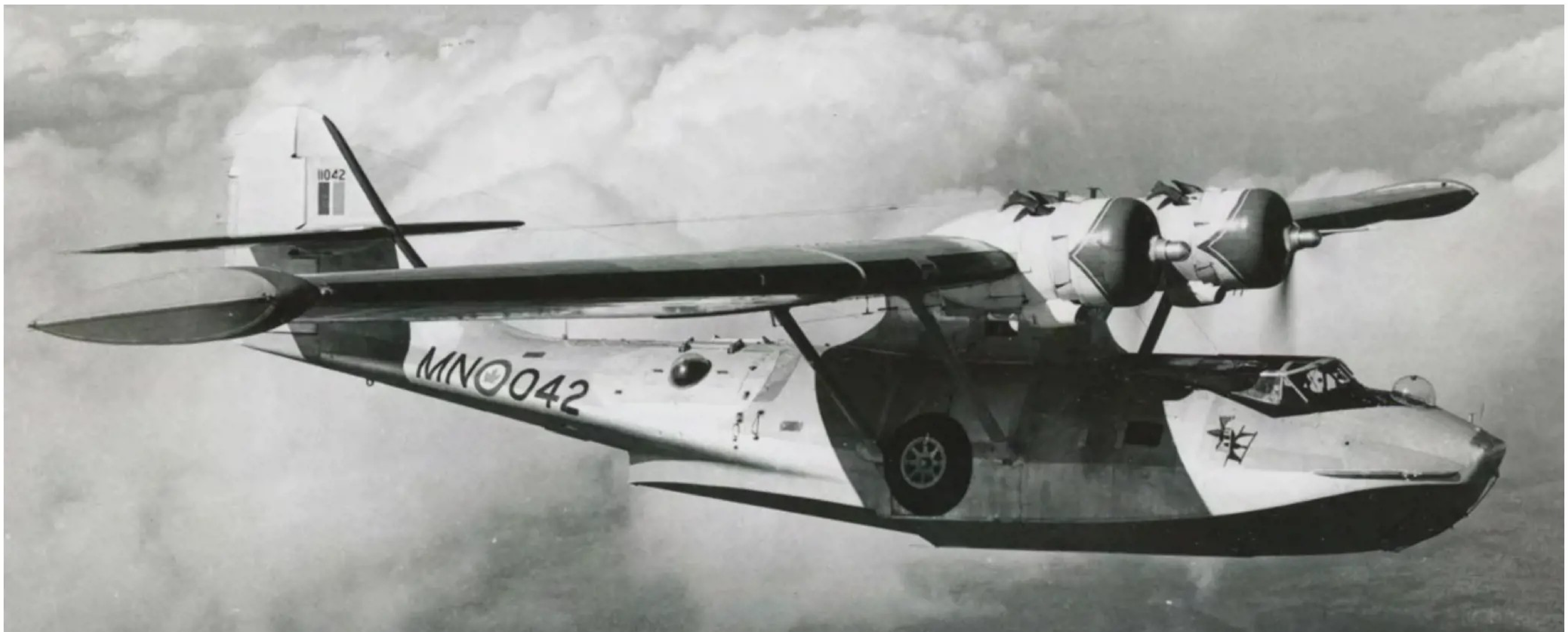
By this time the SB-17s belonged to the USAF's Air Rescue Service (ARS), which was a part of the Military Air Transport Service (MATS) and the B-17s were this command's only armed aircraft. The designation PB-1W was assigned in July 1945 to 31 new B-17Gs transferred to the US Navy and fitted with APS-20 radar under the centre fuselage. The first were issued to patrol bomber squadron VPB-1 in the spring of 1946. Other recipients would be VP-1 at Barber's Point, Hawaii and VP-51 at San Diego, California. The PB-1W's underwing pylons could mount external fuel tanks or weapons. Some PB-1Ws retained all the gun positions of the standard bomber, but again these were generally removed and the aircraft assigned to the airborne early warning role.

In 1946 the US Coast Guard obtained 17 PB-1Gs, some of which were modified with H2X radar and could carry the Higgins lifeboat. Others were used for the International Ice Patrol. The final B-17 in US service was retired by the USCG in October 1959 at Elizabeth City, North Carolina.

Under 1944 ICAO requirements, member countries were obliged to maintain long-range rescue, search and reconnaissance units within their areas of responsibility. The Brazilian Air Force (*Força Aérea Brasileira*) operated 12 SB-17Gs from 1951, half of them on SAR duties and the others used for photo survey and weather reconnaissance. The rescue aircraft were operated by 1º *Esquadrõn* of 6º *Grupo de Aviação* based at Recife. Likewise, Portugal's Air Force also flew SB-17Gs, acquiring five in 1947 and operating them from Lajes in the Azores until 1960 with the *Esquadrilha de Busca e Salvamento*.

Boeing PB-1G

Crew:	Six
Length:	74ft 4in (22.66m)
Wingspan:	103ft 9in (31.62m)
Height:	19ft 1in (5.82m)
Empty weight:	36,135lb (16,391kg)
Max T/O weight:	55,400lb (25,129kg)
Powerplants:	Four Pratt & Whitney R-1820-97 radial engines rated at 1,200hp (895kW) each
Max speed:	310mph (499km/h)
Service ceiling:	35,000ft (10,668m)
Range:	2,500 miles (4,023km)
Armament:	None



Consolidated PBY Catalina

Rescue Cats

The dependable Catalina was the most numerous Allied flying boat series, used in all theatres of war. In the post-war era it gave valuable service in areas that did not yet have airfields suitable for larger aircraft.

The XP3Y-1 (later PBY) was first flown at San Diego in March 1935. The initial production versions were pure flying boats, but from the 1941 PBY-5A onwards they were amphibians with a retractable undercarriage, allowing operation from land bases. Several contractors built the type, including Canadian Vickers and Boeing in Canada. Their aircraft were designated PBV Cansos and PB2B Nomads, respectively, although all models were largely referred to as PBYs or Catalinas outside Canada. Plants in San Diego, New Orleans and Philadelphia built Catalinas for Consolidated. The Soviet Union also produced a small number at the *Gidrosamolet Transportnii* factory at Taganrog as the GST. Excluding Russian-built aircraft, 3,321 Catalinas and derivatives were built.

The versatile Catalina was used for patrol and scouting, air-sea rescue, minelaying, bombing and anti-ship and anti-submarine missions. The 'Black Cats' PBY units made many successful night torpedo attacks in the Pacific against Japanese shipping. The USAAF operated the OA-10A version of the Catalina to provide ASR support for bomber and fighter crews flying from island bases against Japan.. A few OA-10s remained in the USAF inventory until January 1953.

After the war, the numbers in regular US Navy service quickly diminished, with only five Catalinas remaining in the fleet by 1948. Reserve units continued to fly them until January 1957 when the last PBY-6A was retired at Atlanta, Georgia. The US Coast Guard acquired 114 PBYs from 1941, stationing them everywhere from Greenland to the Philippines. In 1954 they were replaced by newer flying boats and many were handed over to Latin American nations under the Mutual Defense Aid Program (MDAP). These included Argentina, Brazil, Cuba, Chile, Colombia and Ecuador. They were often operated on rivers as transports rather than for patrol duties.

The RNZAF received the first of 22 PBY-5s, all amphibians, in 1943. They were supplemented by 36 PB2B-1s with podded radar in 1944. After service as patrol and rescue aircraft in the Pacific, where there were few land airfields, the last were retired in 1953. The RAAF had 168 Catalinas in all, both flying boats and amphibians, operated by four squadrons and various flights.

Sweden operated three examples of the Catalina as the Tp 47. When a Swedish DC-3 (Tp 79) intelligence-gathering aircraft was shot down by Soviet MiG-15s over the Baltic in June 1952, two Tp 47s were sent to search for it. One was attacked by MiGs and forced down on the sea. The crew were rescued by a German freighter. The event became known as the Catalina Affair, because it was not known at first what caused the loss of the DC-3.

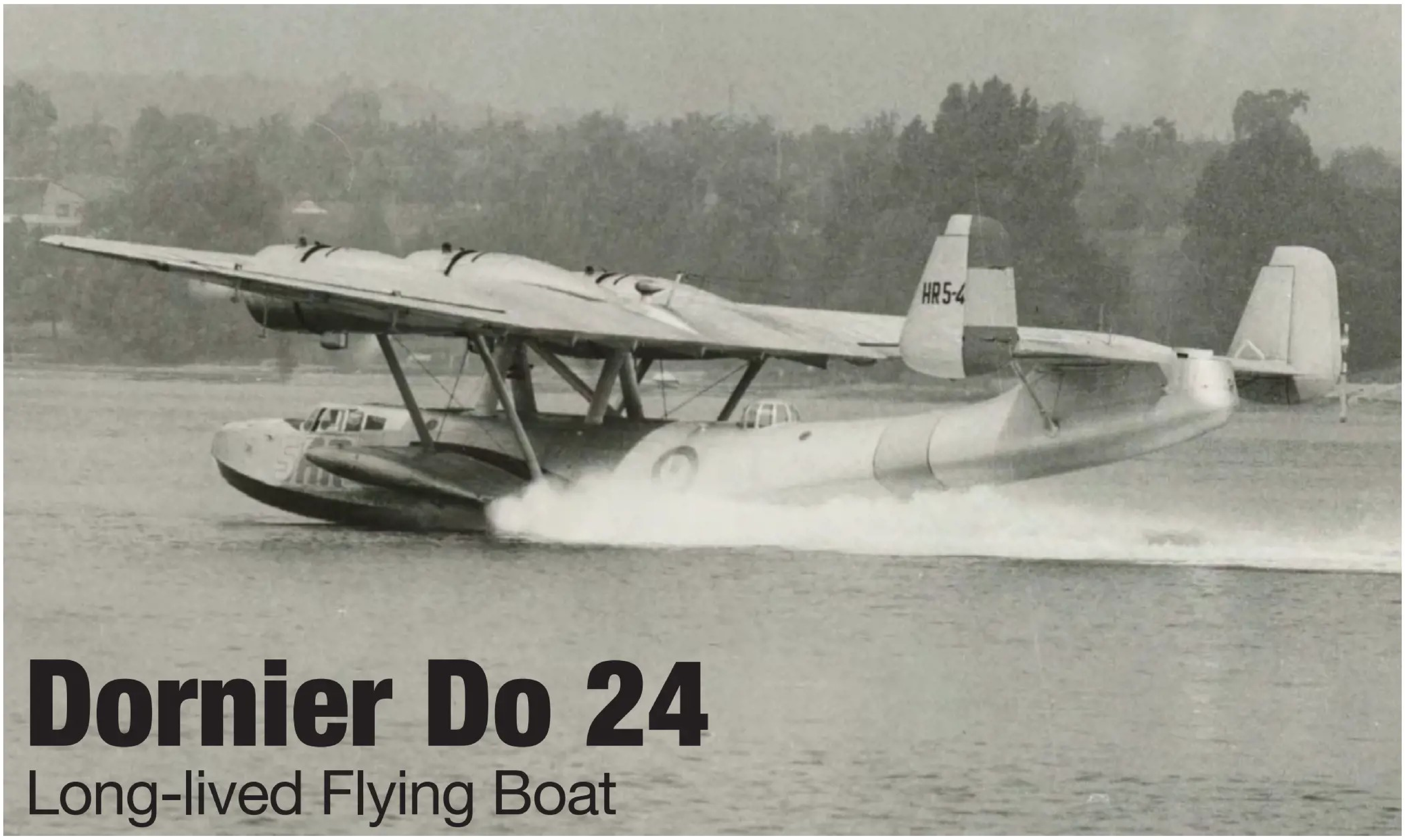
Denmark found the PBY-6A Catalina particularly useful for patrolling Greenland, where it could supply sled patrols and land on ice runways in the interior. The Royal Danish Air Force's 16 aircraft also flew SAR and patrol missions in the Baltic, North Atlantic and Arctic.

The RDAF was probably the last military user, retiring their final three aircraft in December 1970.

Above: ***A Canso of the RCAF's No. 408(PR) 'Goose' Squadron,which was formed at Rockcliffe in 1949 for photo mapping duties.***
Jim Winchester collection

Consolidated PBY-5A

Crew:	7-9
Length:	63ft 10in (19.45m)
Wingspan:	104ft 0in (31.7m)
Height:	20ft 2in (6.15m)
Empty weight:	20,911lb (9,485kg)
Max T/O weight:	35,422lb (16,067kg)
Powerplants:	Two Pratt & Whitney R-1830-92 Twin Wasp radial piston engines rated at 1,200hp (895kW)
Max Speed:	179mph (288km/h)
Service Ceiling:	14,698ft (4,480m)
Range:	2,545 miles (4,095km)
Armament:	up to 4,000lb (1,814kg) of bombs, torpedoes or depth charges, and three 0.30in and two 0.50in machine guns.



Above: ***Do 24T-3 HR.5-4 served with the 51st Rescue Flight of the Spanish Air Force on Majorca until 1969. Later returned to Dornier, its fuselage was to become the basis of the Do 24ATT amphibian.***

Dornier Do 24

Long-lived Flying Boat

The pre-war Do 24 served both sides in World War Two and soldiered on for decades afterwards. A modernised example continues to fly today.

First flown on 3 July 1937, the Do 24 was designed by Germany's Dornier for the Dutch Navy to replace its smaller Wal flying boats. A conventional high-winged seaplane, it was unusual in having three engines, which were Wright R-1820-F52 Cyclones on the Dutch Do 24K aircraft. Stub wings on the lower fuselage containing fuel tanks, gave good buoyancy and sea-keeping.

Do 24s were built in factories in France and the Netherlands, partly to overcome Treaty of Versailles limitations on German aircraft production. When Germany invaded in May 1940, production continued for the *Seenotdeinst* (sea rescue service). Their Do 24T-1 aircraft had BMW engines. The T-1 had a defensive armament of two 7.9mm MG 15 machine guns with 1,200 rounds each and one 20 mm Hispano-Suiza 404 cannon with 225 rounds

In 1938-40, 37 Dutch aircraft were delivered to the Netherlands East Indies Air Force and continued to serve in combat roles, one sinking a Japanese destroyer, until most were lost in action. A few wound up in Australian hands and served the RAAF until 1944.

Factories in France produced 40 Do 24T-3s in wartime and 40 more afterwards, which remained in service up to to 1953, serving in mainland France and Tunisia.

Sweden acquired one example in 1944 when a German mechanic defected with a Do 24T-1 and his girlfriend. The *Flygvapnet* had no other SAR aircraft, so put it in service as the Tp 24. A lack of spare parts brought about its scrapping in 1951. Another Do 24 arrived in Sweden with 37 people aboard in May 1945. The Soviets demanded that it be handed over to them (along with the passengers), and it may have remained in use, probably as a transport, until 1948.

In 1944 12 Do 24T-3s were purchased by the Spanish government to equip a SAR squadron at Pollensa in Majorca. This was part of Spain's obligation to international rescue treaties. They were popular, able to operate in 5ft (1.5m) waves with windspeed above 10kts (19km/h). The Dorniers suffered from corrosion, particularly in their stub-wing fuel tanks, and in 1954 the government ordered their retirement, but five aircraft were revived in 1958-59 and with the help of spare parts from France, Spain kept the last of them airworthy until late 1969.

In the 1960s Dornier proposed a modernisation project, the Do 24/72 with Pratt & Whitney PT6A-50 or Lycoming T5321A turboprops. The wing would have had double-slotted flaps. The Do 24/72 did not proceed, but later the fuselage of an ex-Spanish Do 24T-3 was fitted with a new high-technology wing derived from the Do 328 airliner by Iren Dornier, grandson of the company founder. The Do 24ATT had three PT6 turboprops and a retractable undercarriage. It flew in 2004 and made several long-range flights but remains a one-off.

Dornier Do 24T-1

Crew:	5-6
Length:	72ft 2in (22.0m)
Wingspan:	88ft 7in (27.0m)
Height:	18ft 11in (5.77m)
Empty weight:	20,062lb (9,100kg)
Max T/O weight:	40,565lb (18,400lb)
Powerplants:	Three BMW/Bramo Fafnir radial piston engines rated at 1,000hp (746kW)
Max speed:	211mph (340km)
Service ceiling:	(11,909km) 7,400m)
Range:	2,950 miles (4,748km)
Armament:	up to 2,600lb (1,179kg) of bombs carried under the wings.

Short Sunderland

The Flying Porcupine

One of the greatest flying boats, the Sunderland helped defeat the U-boats in the Battle of the Atlantic and carried on to serve several air arms long after the war before replaced by land-based patrol aircraft.

The Sunderland was derived from the pre-war Short C-class Empire civil flying boat and first flew on 16 October 1937. It was the RAF's largest aircraft when it entered service with No. 210 Squadron in Singapore in June 1938.

Power on the Mk. I, II and III came from four 1,064hp (794kW) Bristol Pegasus radials. This provided barely adequate power for heavily loaded aircraft, which ran their engines at high power settings, reducing reliability. There were only eight Mk. IVs (called the Seaford) with Hercules engines, but the definitive Mk. V had Pratt & Whitney R-1830 Twin Wasps.

Sometimes called the 'flying porcupine', the Sunderland had ten 0.303-in machine-guns: two fixed forward-firing, two in a nose turret, two in a dorsal turret and four in a tail turret. Bombs were loaded on racks inside the hull and moved with pulleys outside to racks under the wings. Up to 4,960lb (2,250kg) of bombs or depth charges could be carried this way.

Sunderland production continued until June 1946 and a total of 777 examples were built. Unlike many other wartime RAF aircraft, the Sunderland was fully owned by Britain and had no immediate successor, so was retained by six operational squadrons into the 1950s.

Sunderlands flew supplies, mainly salt, to the blockaded city of Berlin, landing in a lake in the British Zone. They delivered nearly 5,000 tons of the vital commodity , but unsurprisingly suffered from corrosion and were withdrawn. In Operation Firedog, Nos. 305 and 209 Squadrons bombed insurgents in Malaya and patrolled for Chinese junks bringing them weapons. Sunderlands saw action in the Chinese Civil War, resupplying the stranded HMS *Amethyst* on the Yangste River under Chinese Communist shellfire.

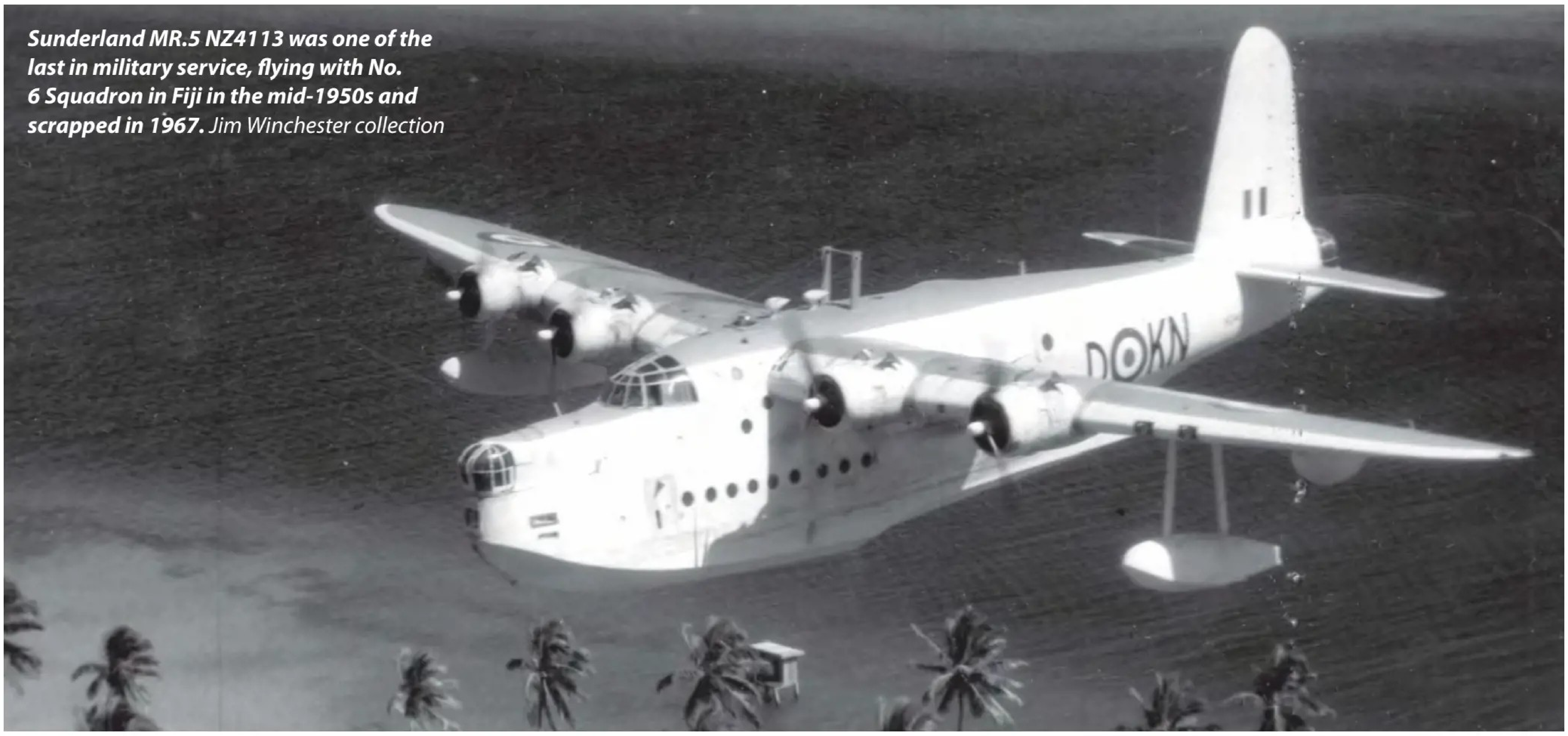
France's *Aéronavale* added 19 refurbished Mk. Vs to some wartime survivors in 1951, basing them mostly in Senegal and retiring the last in 1962. South Africa is probably the least-known operator, receiving 15 Mk.Vs in 1945. Their first task was to repatriate troops from Egypt, after which they were used for coastal patrol by No. 35 Squadron. Numbers slowly declined until the last were replaced by the Avro Shackleton MR.2 in 1957.

One RNZAF squadron operated Sunderland IIIs in West Africa until August 1945, and three more examples served as transports in the Pacific from 1945-47 before being sold on the civil market. In 1952, New Zealand bought 16 refurbished MR.5s, which equipped two squadrons, No. 5 at Hobsonville, Auckland and No.6 at Lauthala Bay, Fiji. Used as transports and for patrol, they were particularly useful in the widely scattered Fijian Islands, which had few airfields.

The last examples in service were those with No.5 Squadron, RNZAF, which finally retired the type in April 1967.

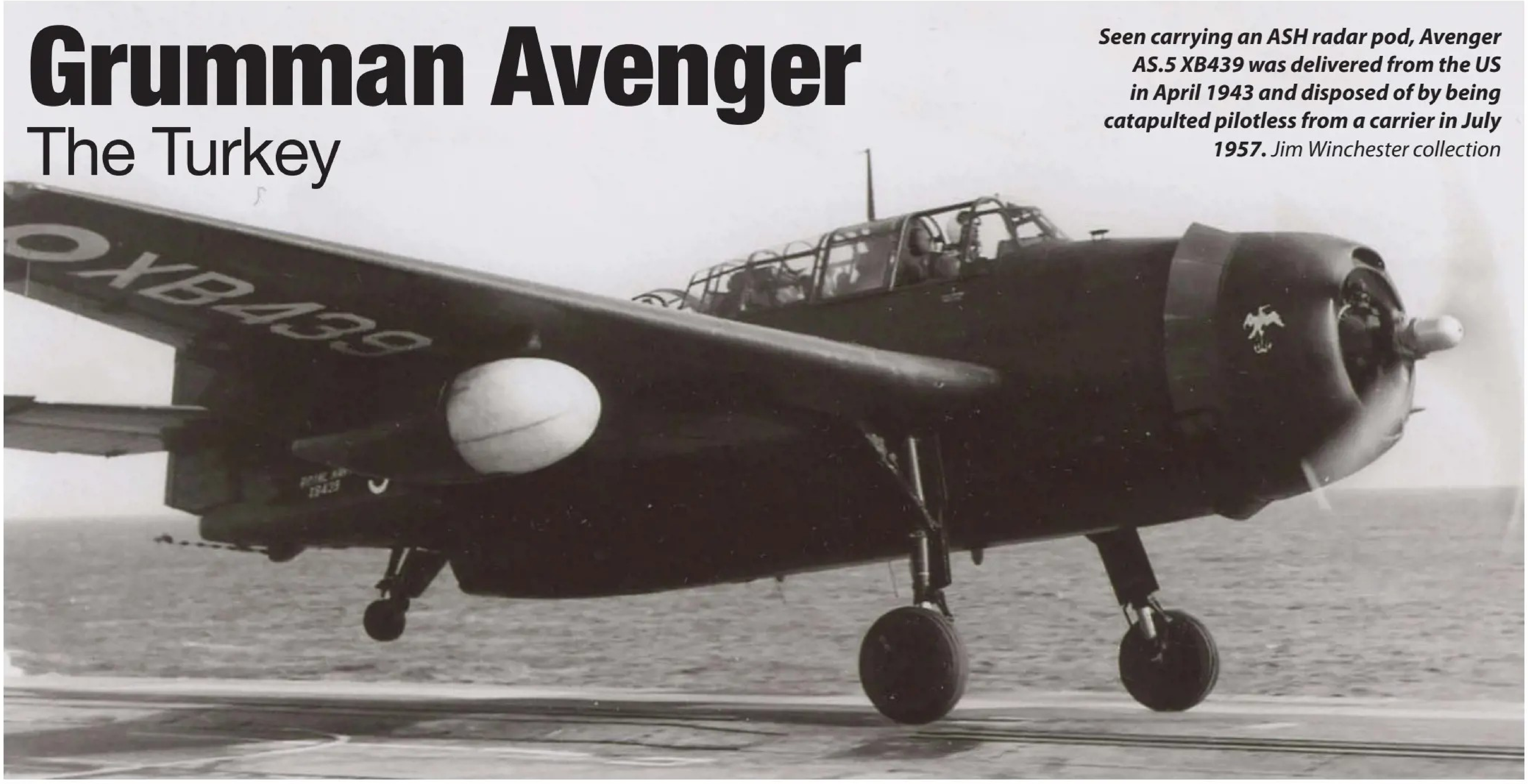
Short Sunderland MR.5

Crew:	9-11
Length:	85ft 4in (26.01m)
Wingspan:	112ft 10in (34.4m)
Height:	32ft 11in (10.02m)
Empty weight:	36,901lb (16,738kg)
Max T/O weight:	58,000lb (26,308kg)
Powerplants:	Four Pratt & Whitney R-1830-90 Twin Wasp radial engines rated at 1,200hp (895kW)
Max speed:	213mph (343km/h)
Service ceiling:	18,000ft (5,486m)
Range:	2,960 miles (4,765km); endurance 13 hours
Armament:	Up to 4,960lb (2,250kg) of bombs or depth charges; two 0.50in machine-guns and ten 0.303in machine-guns


Sunderland MR.5 NZ4113 was one of the last in military service, flying with No. 6 Squadron in Fiji in the mid-1950s and scrapped in 1967. *Jim Winchester collection*

Grumman Avenger

The Turkey



Seen carrying an ASH radar pod, Avenger AS.5 XB439 was delivered from the US in April 1943 and disposed of by being catapulted pilotless from a carrier in July 1957. *Jim Winchester collection*

The largest single-engined aircraft to serve in World War Two, the Avenger torpedo bomber had a significant post-war career as an ASW and patrol aircraft.

First flown on 1 August 1941, the XTBF-1 was named Avenger after the bombing of Pearl Harbor. As a torpedo bomber it was responsible for the destruction of much of Japan's surface fleet. Flying from escort carriers in the Atlantic, they sank many U-boats and kept others below the surface.

Dubbed the 'Turkey' because of its ungainly appearance while landing, the Avenger actually had good characteristics in the carrier pattern and was able to fly from the smaller escort carriers, which were retained for anti-submarine warfare use after the war.

The 2,293 Grumman-built Avengers were TBFs and the 7,546 produced by the Eastern Aircraft Division of General Motors were TBMs, of which the TBM-3 was the main production version.

After the war, US Navy doctrine moved away from slow torpedo bombers for surface attack, but found other uses for the versatile Avenger. Notable among these was as an airborne early warning platform. The TBM-3W was fitted with a belly-mounted APS-20 radar, which greatly improved the carrier group's detection range against hostile aircraft. With a growing Soviet submarine threat, the APS-20 was 'tweaked' to work against small surface targets and aircraft optimised for sub-hunting were designated TBM-3W2; about 160 were converted, replacing TBM-3Es from 1950. The gun armament was removed and rear cockpit faired over to enclose a compartment for radar operators.

Although the Royal Navy had disposed of most of its Avengers after 1945, the Mutual Defense Assistance Pact (MDAP) paid for equipment for NATO nations, and five Fleet Air Arm squadrons were equipped with ASW Avengers between 1947 and 1955. Those units issued TBM-3Es and 100 Avenger AS.4s and 80 AS.5s were Nos. 815, 815, 1830, 1841 and 144 Squadrons, the latter two being Royal Navy Volunteer Reserve units, which were disbanded in 1957. The frontline squadrons made occasional cruises on carriers including HMS *Illustrious* and *Eagle*.

Some of the AS.4s were passed to the French Navy, which also received aircraft from 1951 under MDAP for a total of 140 TBM-3Es, -3S2s, -3Us and -3W2s. They were operated by operational *Flotilles* 4F, 6F, and 9F from shore bases in France and Tunisia and the carriers *Arromanches*, *Bois Belleau* and *Layfayette*. They participated in the Suez Campaign and the last was not retired by the last second-line unit until April 1966.

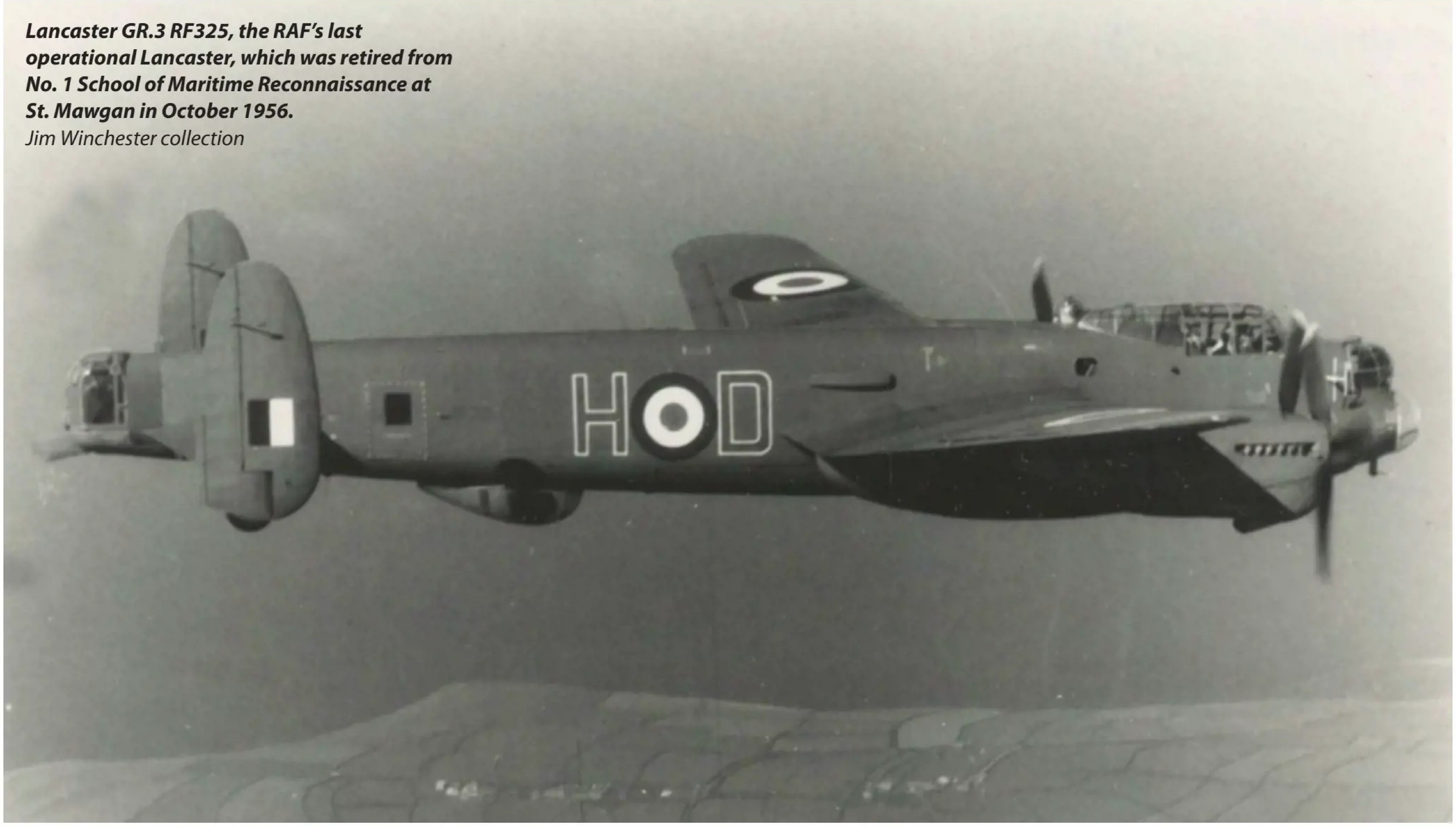
Canada was the recipient of 125 Avengers from 1950, using them for ASW, AEW and target-towing duties. No. 825 and 826 Squadrons flew the AS.3, modified from TBM-3Es with the addition of a MAD boom. They flew alongside TBM-3W2s (Avenger AEWs) from HCMS *Warrior* and *Magnificent* and shore-based units until July 1960.

Among the first aircraft supplied to Japanese forces post-war were ten TBM-3W2s, delivered to the Maritime Guard (later the Japanese Maritime Self Defense Force) in late 1954, followed by ten TBM-3S2s a year later. Used mainly in the ASW training role, the Avengers were not in the best condition and unserviceable aircraft were withdrawn from 1957, with the last retiring in 1961.

In 1950-53 the Netherlands Naval Air Service was supplied with 50 TBM-3S and -3W models, and later received 20 ex-RN TBM-3Es. Operating from HMS *Bulwark* and HrMS *Karel Doorman* until 1960, a few (five or six) were transferred to Brazil. Service was brief as in 1961 responsibility for supplying aircraft for the carrier *Minas Gerais* was passed to the Air Force and the Avengers were grounded. Uruguay's dozen TBM-1Cs and TBF-1s were in service from 1949-60, mostly on coastal patrol duties.

Grumman (Eastern Aircraft) TBM-3E Avenger

Crew:	Three
Length:	41ft 0in (12.50m)
Wingspan:	54ft 2in (16.51m)
Height:	16ft 5in (5.0m)
Empty weight:	10,545lb (4,783kg)
Max T/O weight:	17,895lb (8,117kg)
Powerplant:	One Wright R-2600 Twin Cyclone radial engine rated at 1,900hp (1,417kW)
Max speed:	276mph (444km)
Service ceiling:	30,100ft (9,174m)
Range:	1,920 miles (3,090km)
Armament:	2,000lb (907kg) of stores including bombs, depth charges, torpedoes and rockets



Lancaster GR.3 RF325, the RAF's last operational Lancaster, which was retired from No. 1 School of Maritime Reconnaissance at St. Mawgan in October 1956.
Jim Winchester collection

Avro Lancaster Patrol Variants

Post-War Lancs

Famed as an RAF heavy bomber, the Lancaster flew with three air forces post-war as an air-sea rescue and maritime patrol aircraft, seeing service into the 1960s.

As the war came to an end, the RAF was left with many low-houred Lancasters at the same time it had to return the B-24 Liberators in Coastal Command under the terms of the Lend-Lease agreement with the USA. Tiger Force, the Commonwealth air contribution to the planned invasion of Japan, would require long-range air-sea rescue cover for Lancaster and Lincoln bombing missions and it was decided to convert Lancaster B.IIIs to ASR.3 standard. These could carry a 30ft 6in (9.3m) lifeboat, and its makers, Cunliffe-Owen at Southampton, were contracted to supply 130 conversions, the first of which appeared in early 1945. The dorsal turret was removed and extra windows were added in the rear fuselage and extra antennas were fitted to receive distress transmissions.

Only one squadron (No. 179) was partly equipped with ASR.3s by September 1945 when the Pacific war ended, but there was still a need for rescue and patrol aircraft in the Far East and elsewhere, so deliveries continued. The Lancaster GR.3 (the initials standing for General Reconnaissance) was a more refined conversion with centimetric ASV radar, but could also carry a lifeboat when required. They could deploy sonobuoys and flares, used for illuminating surface targets at night.

The GR.3 was later redesignated MR.3 (for Maritime Reconnaissance). The GR.3/MR.3 and ASR.3 Lancasters served with Nos. 18, 37, 38, 120, 160, 179, 203, 210, 279 and 621 Squadrons. No. 1348 Flight flew the ASR.3 in Burma until March 1946. The last Maritime Lancaster unit was No. 38 Squadron, which was initially based in Palestine and, from April 1948, Malta, with responsibility for patrolling the eastern Mediterranean. The squadron converted to Shackleton MR.2s and retired its last Lancaster in December 1954.

The final operational flight of an RAF Lancaster was by an MR.3 of the School of Maritime Reconnaissance at St. Mawgan, Cornwall, on 15 October 1956.

The Lancaster was also manufactured in Canada by Victory Aircraft Limited (later Avro Canada) in Malton, Ontario, where 430 Mk, X versions were built, many of which were issued to Canadian-manned Bomber Command squadrons in the UK. Most surviving examples returned to Canada after V.E. Day and preparations began to equip them for tropical

Lancaster Mk. 10MR

Crew:	7-8
Length:	69ft 6in (21.18m)
Wingspan:	102ft 0in (31.09m)
Height:	20ft 0in (6.10m)
Empty weight:	35,240lb (15,999kg)
Max T/O weight:	60,000lb (27,400kg)
Powerplants:	Four Packard Merlin 224-5 piston engines rated at 1,640hp (1,224kW)
Max speed:	272 mph (438 km/h)
Service ceiling:	24,700ft (7,528m)
Range:	2,530 miles (4,072km); endurance up to 12hr
Armament:	Nose and tail gun turrets, each with two or four 0.303 Browning machine-guns, and up to 14,000lb (6,350kg) weapons load

The first of France's 54 Lancasters, Mk. V11 WU-01, formerly NX613, was handed over to the Aéronavale in December 1951.

use as part of Tiger Force. When the atomic bombings of August 1945 brought the war to a sudden end, about 150 Canadian Lancasters were put into storage.

Many would be selected for new roles as anti-submarine patrol aircraft, ice reconnaissance or photographic mapping. There were 62 examples of the Lancaster 10MP (for Maritime Photographic, later redesignated Lancaster 10MR for Maritime Reconnaissance). These had an additional 400 Imp. gal. (1,818 litre) bomb-bay fuel tank, sonobuoy capability and (later) APS-33 radar in a ventral turret.

The Lancasters mainly served with Nos. 404 and 405 Squadrons at Greenwood, Nova Scotia, and No. 407 Squadron at Comox, British Columbia, which transitioned to the Neptune in May 1958. Up to 12 others became Lancaster 10SRs, operated by Nos. 103 and 107 Rescue Units and later No. 405 Squadron.

At the time of the Cuban Missile Crisis in October 1962, RCAF SAR Lancasters flew ASW patrols off Canada's eastern seaboard, even though they lacked equipment for finding submarines.

As part of military aid to France, Britain agreed to supply the *Aéronavale* with Lancasters for the surveillance maritime (SURMAR) role in 1948. Avro was concentrating on Lincoln work and deliveries of modified aircraft to Flottille 2F in Morocco did not begin until February 1952. The Mk. VII Lancaster had ASV radar, bomb-bay fuel tanks and pick-up points for lifeboats. Other French Lancaster units were *Flottilles* 10F in Brittany and 11F in Algeria, *Escadrilles* 55S and 56S in Morocco, 4S in Algeria, and 9S in the Pacific. The last French Lancasters were retired by 9S in 1964 and several made their way into preservation.

ROYAL CANADIAN AIR FORCE
213
RESCUE
COMMAND

Lancaster 10MR FM213 served with No. 107 Rescue Unit at St. Johns, Newfoundland on SAR duties. It is airworthy today with the Canadian Warplane Heritage Museum in Ontario.

Convair PB4Y Privateer

Last of the Liberators

With its long range and many observation positions, the B-24 bomber made an acceptable patrol aircraft, but a more effective version came along near war's end and flew some important Cold War missions.

Following the example of the RAF, which operated the Liberator over the Atlantic, from 1942, nearly 1,000 B-24 Liberators were purchased for anti-submarine patrol by the US Navy as the PB4Y-1. They were successful against U-boats but lacked effective defensive armament against fighters. Powered nose and tail turrets were fitted to some PB4Y-1s, but a version more suitable for patrol than high-level bombing was desired. A contract for a stretched variant was issued in May 1943. Wind tunnel tests showed that a single fin and rudder as used on the RY-3 transport gave more stability and this was incorporated into the PB4Y-2 design, which was different enough to be renamed Privateer.

The XPB4Y-2 was first test flown on 20 September 1943, initially with the standard twin-tail layout. The turbo-superchargers were replaced by mechanical superchargers, which were more efficient at low level. Soon, 1,370 PB4Y-2 Privateers were on order, although only 736 would be completed by war's end.

Production examples, delivered to VPB (patrol bomber) squadrons from May 1944, had power-operated Erco nose and tail turrets and twin Martin dorsal turrets, plus side blisters, for a total of 12 0.50in calibre machine-guns. The blister guns could be angled downwards to cover most of the underside, replacing the B-24's ball turret. Some Privateers were equipped with the ASM-N-2 Bat anti-shipping radar-homing glide bombs, used from April 1945 on land targets in Borneo and against Japanese shipping.

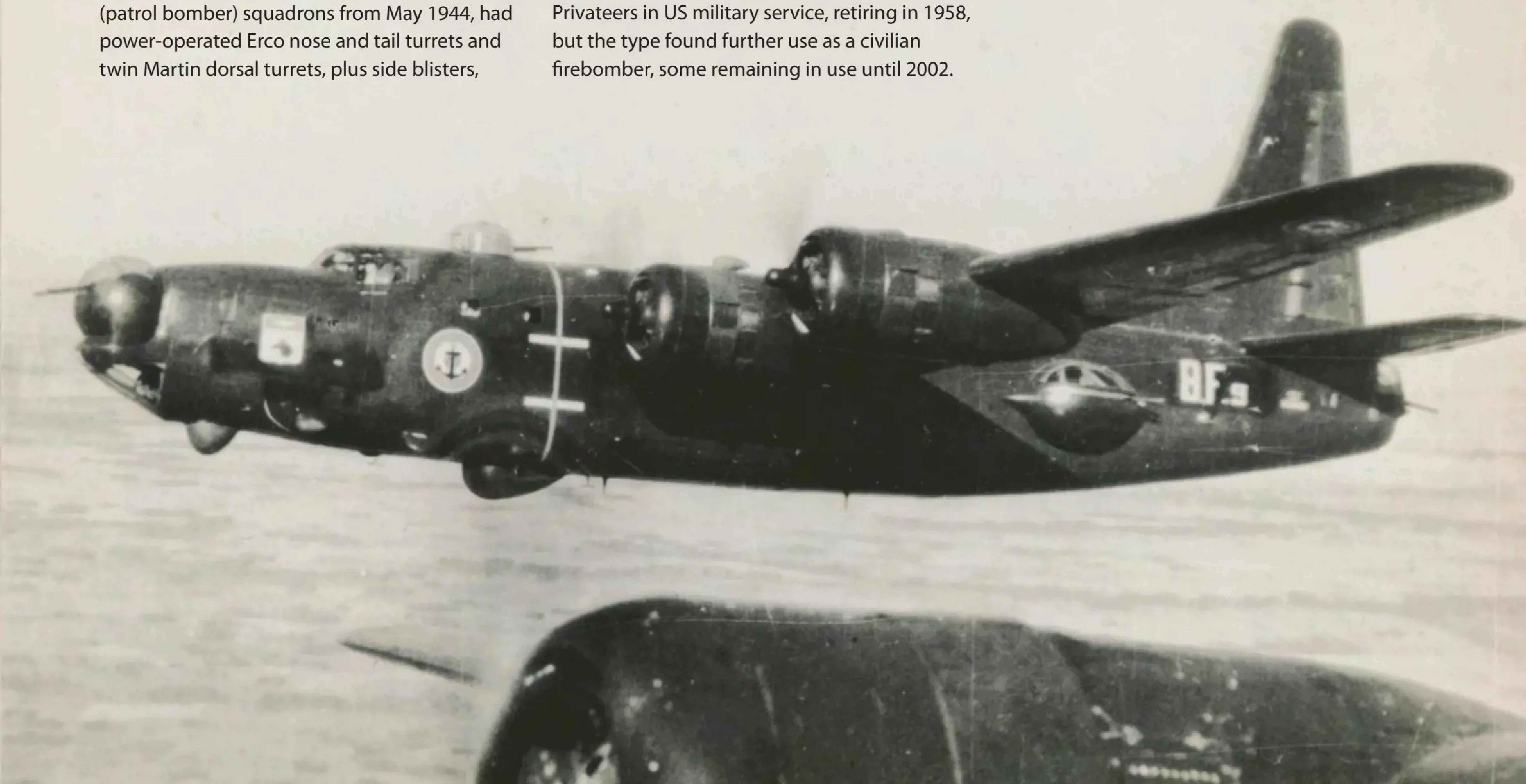
Equipped with a variety of radar and radio receivers, the Privateer had a secondary 'sniffer' role for electronic and radio emissions. On 8 April 1950, a PB4Y-2 named *Turbulent Turtle* of VP-26 Detachment A, normally based at Port Lyautey, French Morocco, was flying a Baltic Sea reconnaissance mission from a West Germany base when it was shot down by Soviet La-11 fighters near Latvia. The crew of ten were declared missing.

There were several post-war variants, including the PB4Y-2S fitted with ASW radar. In 1950 22 of these were supplied to France, serving with Flotilles 6F, 8F, and 28F. They were mainly used for standard bombing duties in Indochina and Algeria and took part in the Suez campaign. Some were returned to the US or lost in action, but the survivors were scrapped in early 1961.

The US Coast Guard acquired nine PB4Y-2Gs with their nose and tail turrets replaced by extensive glazed sections. These were the last Privateers in US military service, retiring in 1958, but the type found further use as a civilian firebomber, some remaining in use until 2002.

PB4Y-2G Privateer

Crew:	11
Length:	74ft 7in (22.73m)
Wingspan:	110ft (33.53m)
Height:	30ft 1in (9.17m)
Empty weight:	37,485lb (17,000kg)
Max T/O weight:	65,000lb (29,484kg)
Powerplants:	Four Pratt & Whitney R-1830-94 radial piston engines each rated at 1350 hp (1,007kW)
Max speed:	237mph (381km)
Service ceiling:	20,700ft (6,309m)
Range:	2,800 miles (4,506km)
Armament:	12 0.50in machine-guns; up to 5,800kg (of bombs, mines, or torpedoes



Below: ***This PB4Y-2 flew with the* Aéronavale's Flotille *28F in Indochina in 1954.***
Jim Winchester collection

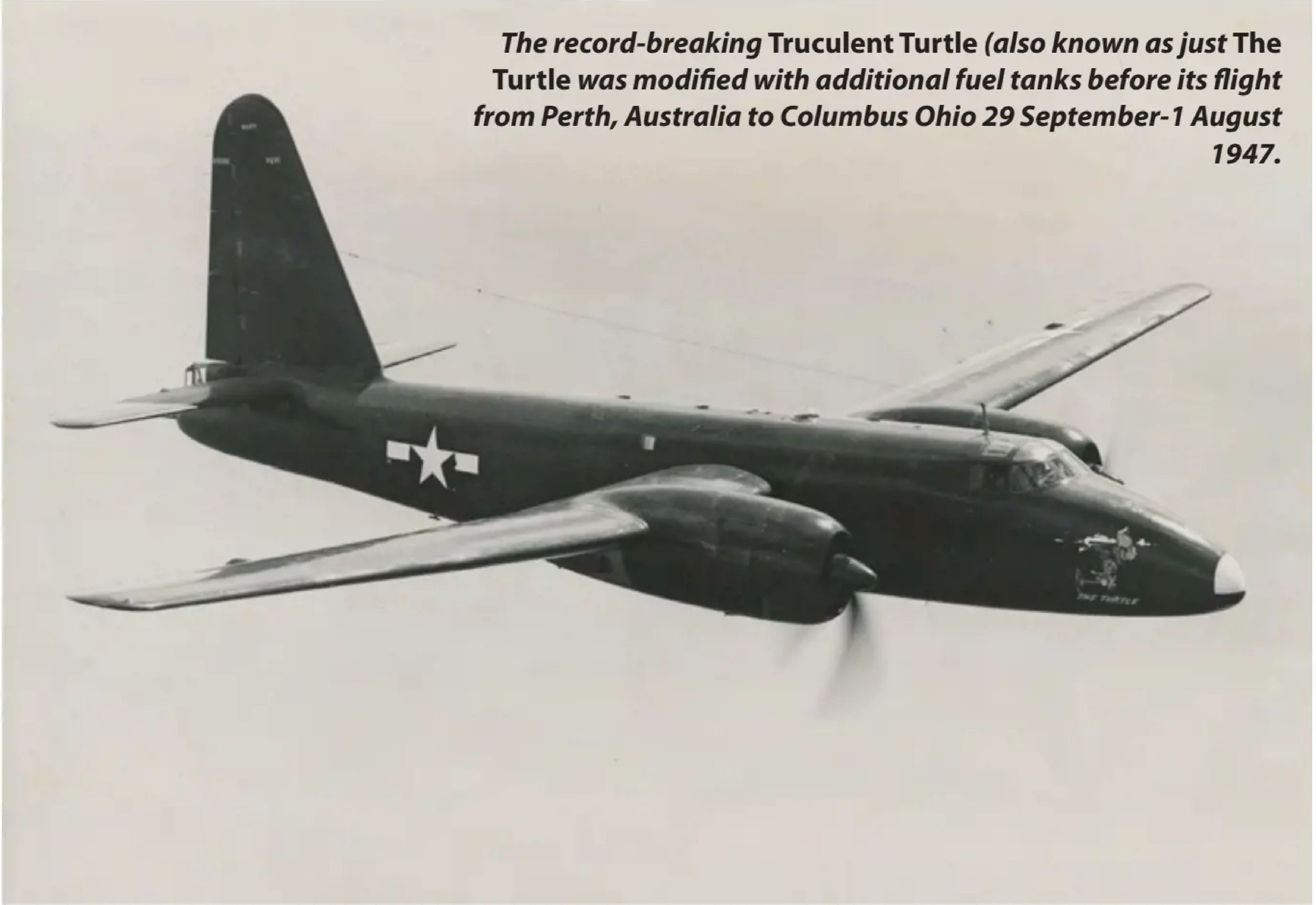
Lockheed Neptune

Purpose-Built Patroller

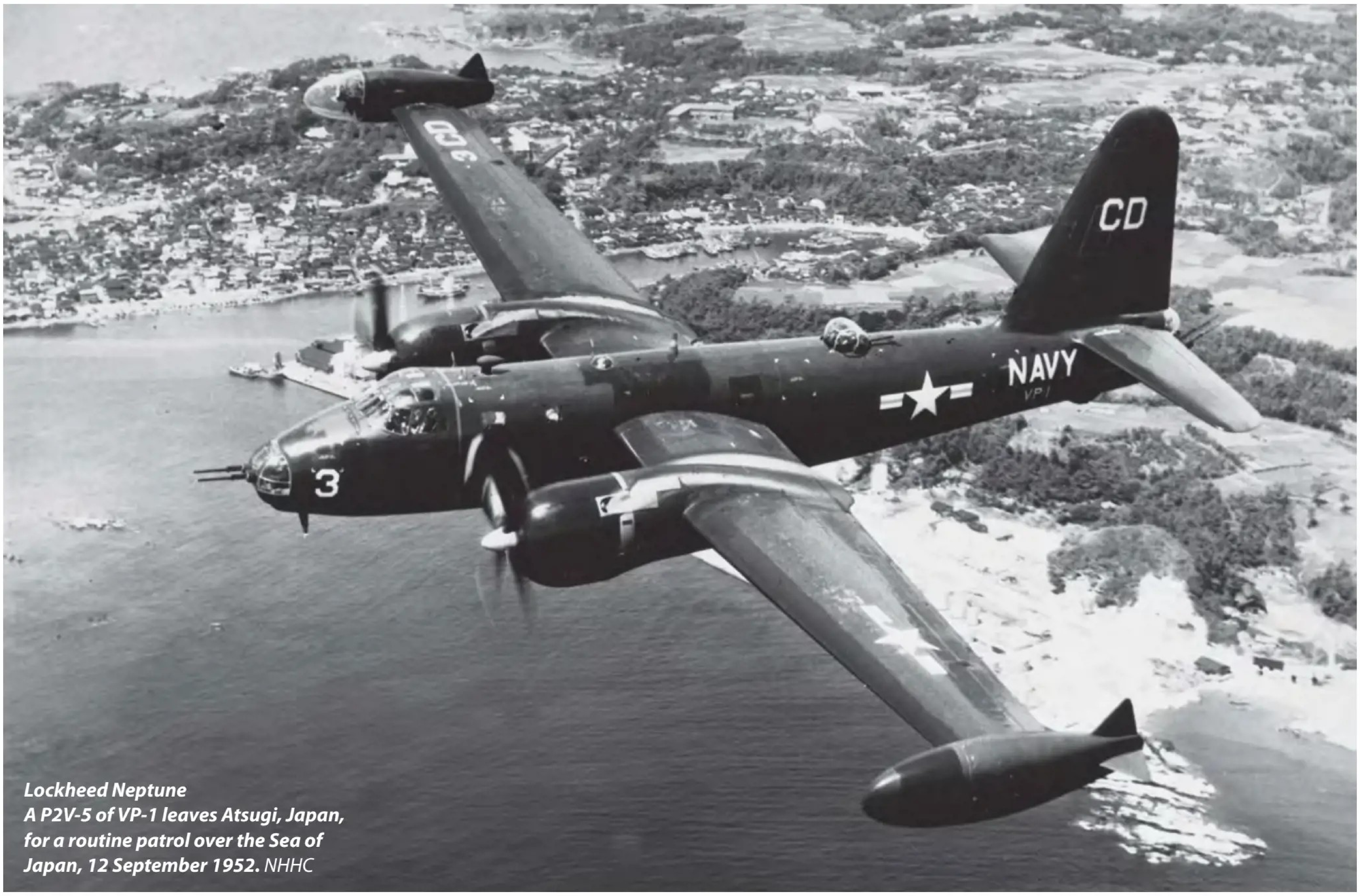
The Neptune was one of the few patrol aircraft built as such from the outset, rather than converted from an airliner or bomber. It was used by the US Navy, Air Force and Army and by many allied countries, seeing action in a number of conflicts.

Various converted transport and bomber types were operated as land-based patrol aircraft by the US Navy during the war, but they became increasingly cramped as internal equipment proliferated and weights grew, affecting endurance. A clean-sheet design was ordered from Lockheed in 1944, with ample space for crew and electronics, and increased range. Two XP2V-1s and 15 production aircraft were contracted. The first prototype took flight on 12 May 1945.

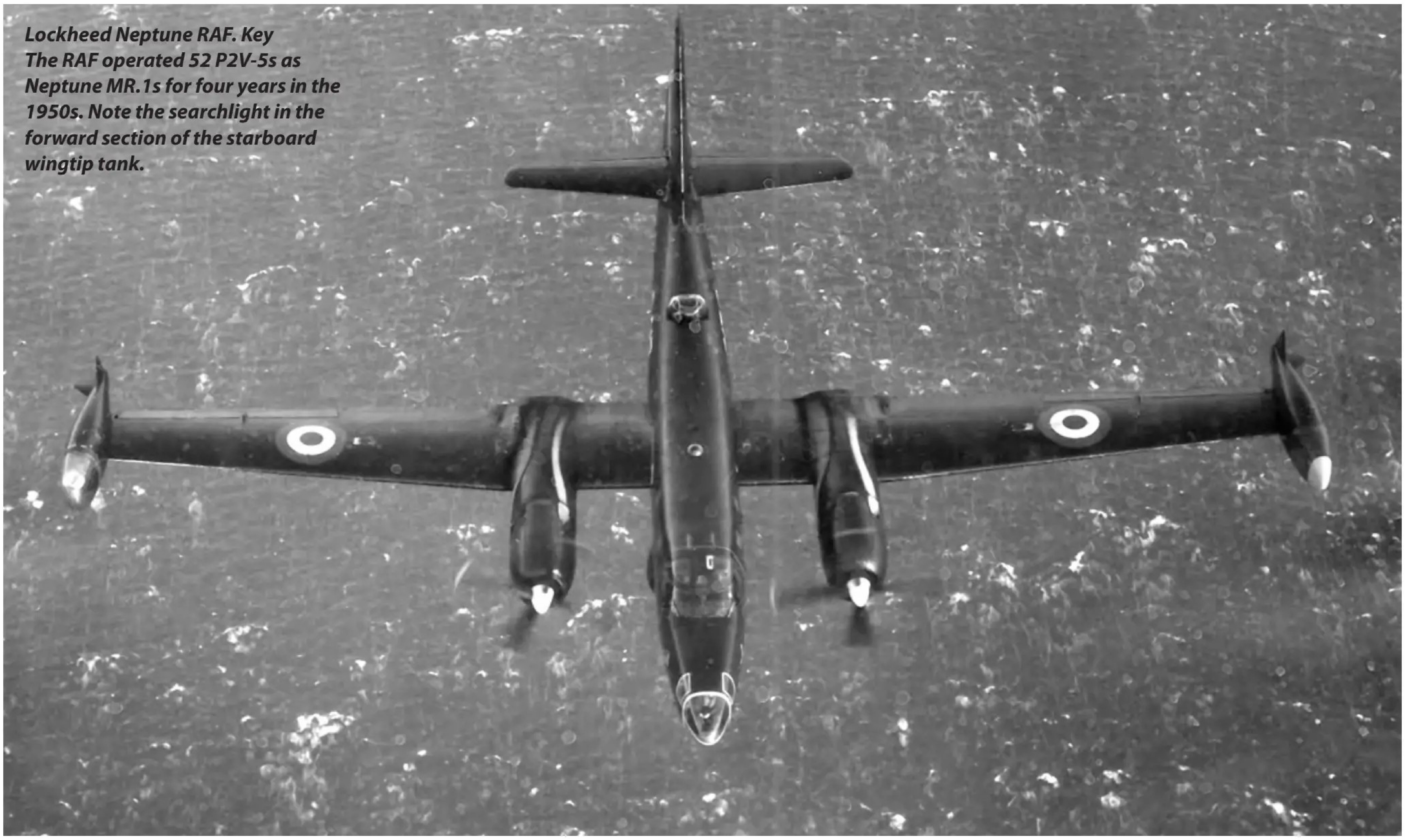
One early Neptune, named *The Truculent Turtle* set a world non-stop unrefuelled flight distance of 11,235.6 miles (18081.9km), flying between Perth, Australia, to Columbus, Ohio in 55hrs, 17min in September 1947. This record stood until 1962 when broken by a B-52 bomber.



The record-breaking* Truculent Turtle *(also known as just* The Turtle *was modified with additional fuel tanks before its flight from Perth, Australia to Columbus Ohio 29 September-1 August 1947.



Lockheed Neptune
A P2V-5 of VP-1 leaves Atsugi, Japan, for a routine patrol over the Sea of Japan, 12 September 1952. *NHHC*

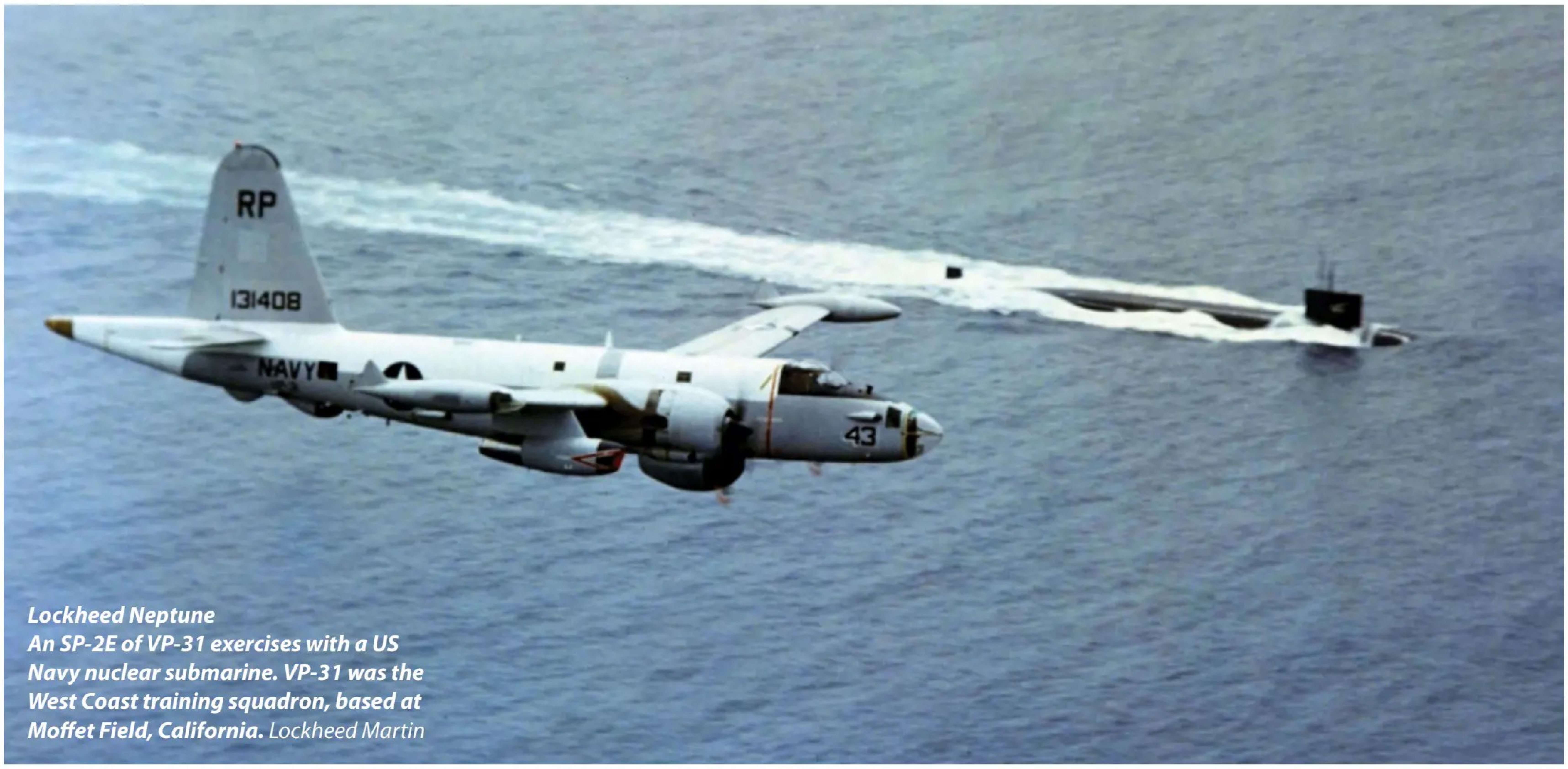


Lockheed Neptune RAF. Key
The RAF operated 52 P2V-5s as Neptune MR.1s for four years in the 1950s. Note the searchlight in the forward section of the starboard wingtip tank.

Following initial trials, the first P2V-1s went into service with VP-ML-2 in 1947. This short-lived unit designation stood for Medium Patrol Squadron (Landplane). Only 14 -1s were built before production switched to the -2 with a solid nose, a dorsal turret and a Bell or Emerson tail turret. The P2V-2N was ski-equipped for polar rescue missions and other later versions were used in Antarctica.

The P2V-3 had uprated engines, but was largely the same as its predecessor. There were 30 P2V-3W early warning/Elint platforms and two P2V-3Z armed VIP transports. One P2V-3W was shot down by MiGs over eastern Russia in November 1951.

The P2V-3C was the first naval aircraft capable of carrying a nuclear weapon. The Navy was worried that they would lose the battle for funding with the Air Force if land-based bombers monopolised the atomic strike role. The Neptune was barely suitable for carrier operations and could not be stored in the



Lockheed Neptune
An SP-2E of VP-31 exercises with a US Navy nuclear submarine. VP-31 was the West Coast training squadron, based at Moffet Field, California. *Lockheed Martin*

An impressive formation of JMSDF Neptunes near Mt. Fuji. Japan was the largest non-US operator, with 146 airframes supplied or built under license. *Japan Ministry of Defense*

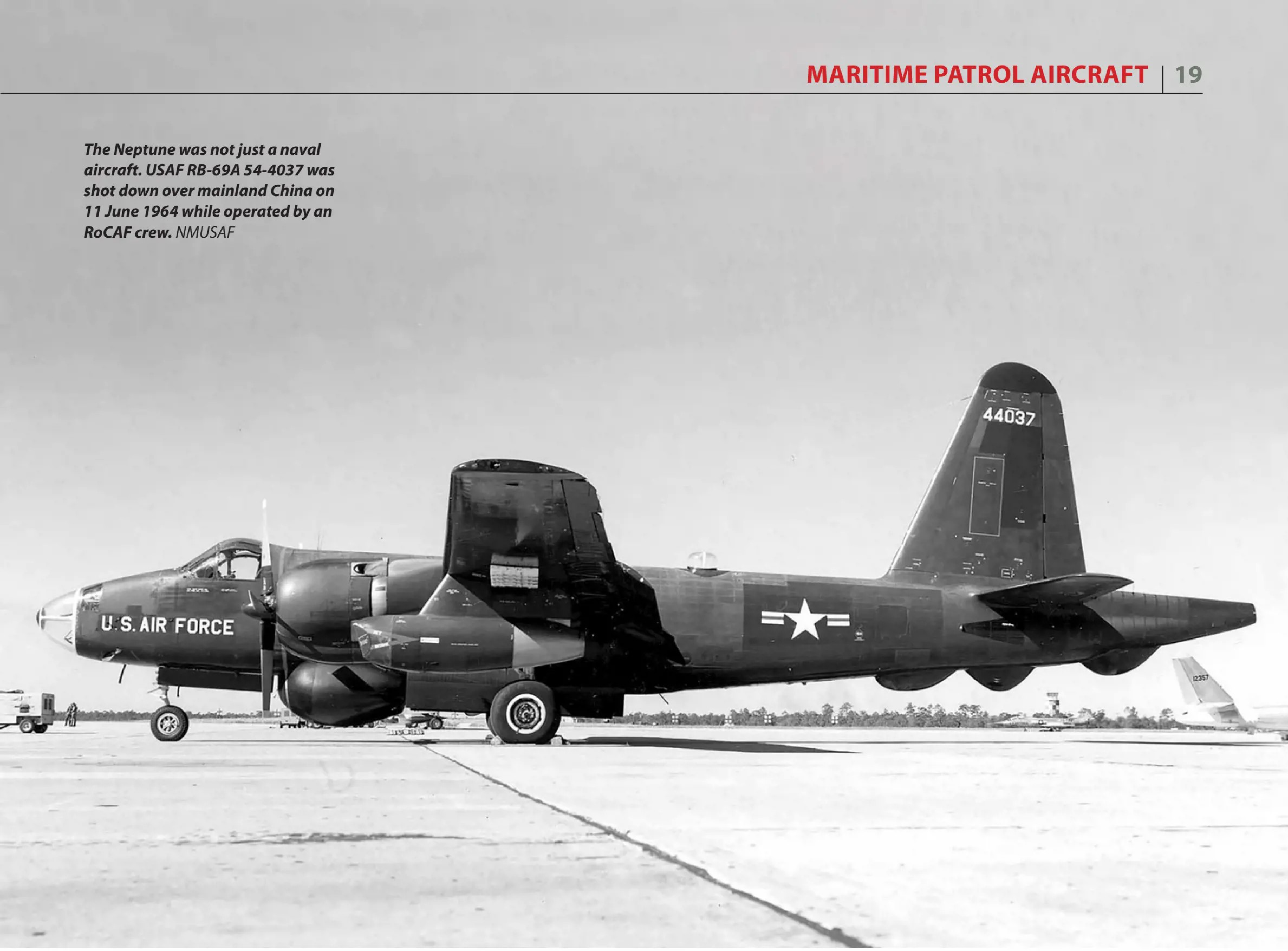
hangar deck. With the help of jet-assisted takeoff (JATO), and the removal of most armament and search equipment, the Neptune could be launched from the three *Midway*-class carriers with a single Mk. 8 30 kiloton nuclear bomb. To get the aircraft aboard required a large crane. Only 12 P2V-3Cs were converted and served from 1949-1952, replaced by the A2J Savage and then the A3D Skywarrior.

The P2V-4 was again similar, but had four-bladed propellers and wingtip fuel tanks. A sonobuoy operator was added to the crew. The P2V-5 added more ASW and ECM equipment and yet another crewman. During production its nose turret was replaced by a clear observation bubble and the tail guns with a MAD boom. Sub-variants included the P2V-5F, which was equipped with a pair of Westinghouse J34 engines in underwing pods. Their additional thrust improved takeoff performance and increased endurance by allowing more fuel. Sub-sub variants were the P2V-5FD (later DP-2E) drone controller, P2V-5FE (EP-2E) with extra electronics and P2V-5FS (SP-2E) with the Julie-Jezebel sonar system.

The P2V-6 featured the Emerson nose turret and APS-70 radar in a smaller radome. It became the P-2G, and the J34-equipped P2V-6F became the P-2F. The P2V-7 was the last US-built model, with the J34s fitted on the production line rather than as a retrofit. It also had an enlarged canopy and APS-20 radar. Turrets were eliminated during production, but rocket rails were retained.

US Navy Neptunes saw service in Korea and Vietnam. In the latter they took over from P5M Marlins on Operation Market Time, interdicting boats supplying Vietcong insurgents in the south. Straying far from the original maritime role, the Navy converted 12 aircraft to OP-2E gunships with underwing Minigun pods and four to AP-2Hs with a tail turret and various sensors for night operation. These were based in Thailand, mostly dropping motion sensors on the Ho Chi Minh Trail, but the AP-2Hs also used bombs and napalm against ground targets. The Navy was not the only US user. In collaboration with the CIA, the USAF took seven P2V-7s on loan, which were heavily modified and redesigned as RB-69s. The aircraft were all different, equipped for electronic intelligence (Elint), jamming, leaflet dropping, photography and even agent pickup using the 'Skyhook' system. They served in West Germany and the Republic of China (Taiwan). Notionally operated by the RoCAF, they made many clandestine flights over the mainland, where four were shot down or disappeared. The US Army also operated five AP-2Es on Elint missions over Southeast Asia.

As an interim patrol aircraft between the Lancaster and Shackleton, RAF Coastal Command received 52 P2V-5s in 1952. They served with Nos. 36, 203, 210 and, 217 Squadrons and Fighter Command's No. 1453 Flight on AEW duties. After only four years they were disposed of, some to Argentina and Brazil. France operated nearly as large a fleet, the *Aéronavale* acquiring 26 P2V-6s and 34 P2V-7s from 1953 until 1984. Used for ASW, reconnaissance and minelaying, they saw some action in support of French troops in Algeria. The Netherlands Navy received three batches of



The Neptune was not just a naval aircraft. USAF RB-69A 54-4037 was shot down over mainland China on 11 June 1964 while operated by an RoCAF crew. *NMUSAF*

Neptunes from 1953, amounting to 12 P2V-5s, 15 P2V-7s and four ex-French SP-2Es. They were operated by No. 320 Squadron at Valkenburg and No. 321 Squadron at Hato in the Dutch Antilles. The Dutch P2V-5s were transferred to the *Força Aérea Portuguesa* in 1961-62. They were deployed to Angola, Guinea-Bissau and São Tomé in support of Portugal's colonial wars and occasionally used as bombers.

Canada replaced the Lancaster with the P2V-7, 25 examples of which served from 1954 with Nos. 404, 405 and 497 Squadrons. They were equipped with the auxiliary jet engines from 1957. The RAAF operated 12 P2V-5s and 12 P2V-7s with Nos. 10 and 11 Squadrons, respectively.

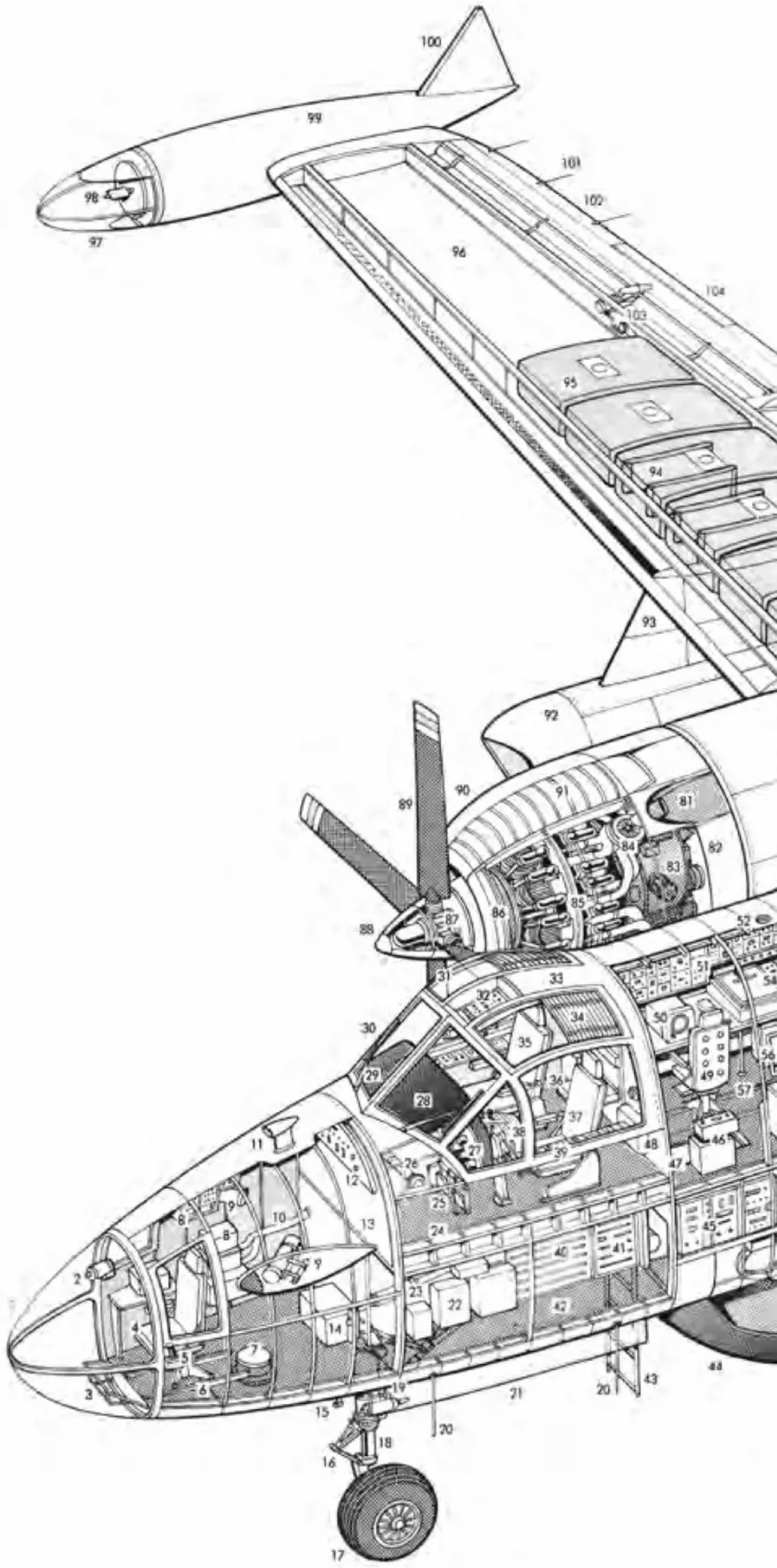
Japan was the major export user, firstly with 16 P2V-7s purchased from the US. These were followed by 48 SP-2Hs built under license by Kawasaki. An upgrade programme, initially designated P2V-7 Kai (for *Kaizen* or 'improvement') replaced the radar with the P-3 Orion's APS-80 and extended the fuselage by 54in (1.37m). Most importantly, the engines were exchanged for GE T64 turboprops, built by IHI supplemented by a pair of J3-IHI-7C turbojets. The extra power required an enlarged rudder. Tests of a prototype in July 1966 were followed by 82 more, designated P-2J, between 1969 and 1979. Top speed increased, empty weight decreased and payload went up compared to the SP-2H. By the late 1980s, all but three UP-2J utility aircraft used as drone launchers and for ECM training were retired.

Argentina was one of the longest and last users. Eight ex-RAF and ex-Dutch P2V-5s arrived in 1958, four SP-2Es from the US in 1966 and four SP-2Hs in 1977-78. These last aircraft remained in service in 1982, but only two were serviceable enough to fly in support of Falklands operations. They flew some missions in attempts to locate British submarines and others as early warning platforms without success. Antiquated equipment and jamming defeated them, but on 4 May, they used their radar to provide targeting data to Super Etendards, which went on to sink the destroyer HMS *Sheffield*. After this the Neptunes were flown into storage and eventually replaced by Lockheed Electras.

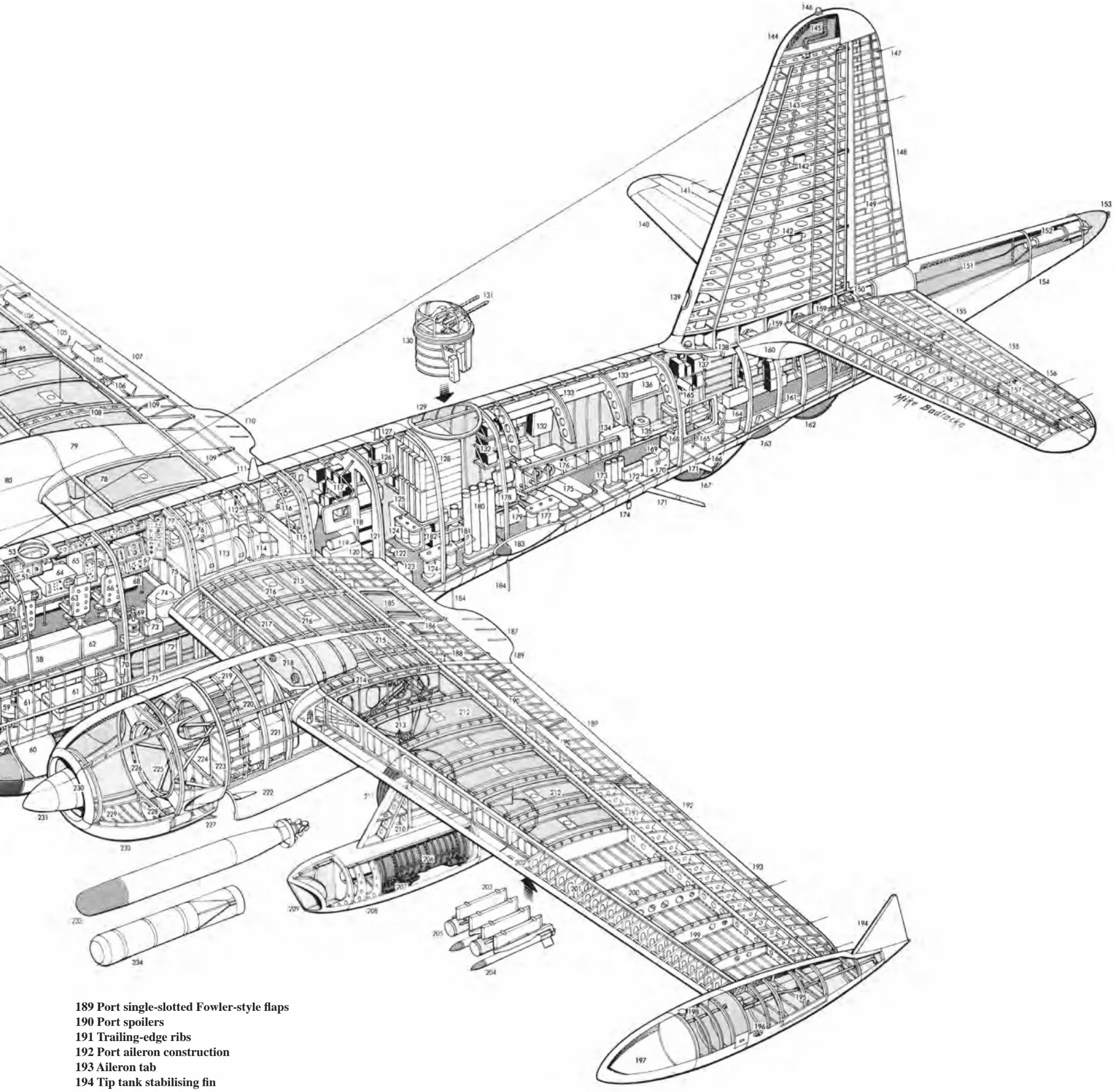
Lockheed P2V-7 Neptune

Crew:	Ten
Length:	91ft 8in (27.94m)
Wingspan:	103ft 10in (31.65m)
Height:	29ft 4in (8.94m)
Empty weight:	49,935lb (22,650kg)
Max T/O weight:	79,895lb (36.240kg)
Powerplants:	Two Wright-3350-32W piston engines rated at 3,700hp (2,759kW) and two Westinghouse J34 turbojets rated at 3,400lb st (15.12kN)
Max speed:	403mph (648km/h) with jets
Service ceiling:	22,000ft (6,700m)
Range:	2,500 miles (4,000km)
Armament:	Provisions for two torpedoes, mines, depth charges, bombs internally plus eight rockets externally

Lockheed SP-2H Neptune



1 Nose compartment glazing
2 Course indicator
3 Footrest
4 Observer's seat
5 Searchlight hand controller
6 Sliding seat rails
7 AS-578/ARA-25 antenna
8 Instrument consoles
9 ALR-3 antenna
10 Heater ducting
11 Cold air intake
12 Ditching panel
13 Cockpit/nose compartment bulkhead
14 ASR-3 amplifier
15 Temperature probe
16 Torque scissor links
17 Aft retracting nosewheel
18 Nose undercarriage leg strut
19 Nosewheel steering jack
20 ARR-26 aerials
21 Nosewheel doors
22 Electrical system relay panels
23 Nose undercarriage hydraulic retraction jack
24 Cockpit floor level
25 Rudder pedals
26 Cockpit heater duct
27 Instrument panel
28 Instrument panel shroud
29 Windscreen wipers
30 Windscreen panels
31 Cockpit roof glazing
32 Overhead switch panel
33 Cockpit roof escape hatches
34 Sun visor
35 Co-pilot's seat
36 Aircraft captain's folding seat
37 Pilot's seat
38 Control column
39 Side console panel
40 Nosewheel bay
41 Entry doorway from wheel bay
42 Lower deck walkway
43 Retractable boarding letter
44 Ventral radome
45 Hydraulic system panel
46 Tape recorder
47 Access hatch from lower deck
48 Parachute stowage
49 'Jezebel' operator's seat
50 AQA-3 indicator
51 Overhead instrument and control consoles
52 Sextant aperture
53 Astrodome/escape hatch
54 Plotting board
55 Navigator's seat
56 Cabin window panel
57 Seat mounting rails
58 Electrical system distribution centre
59 Radar scanner drive unit
60 APS-20B search radar scanner
61 Radar electronics equipment bay
62 Electrical system secondary load centre
63 Tactical Commander's seat
64 ASA-16 indicator
65 ASA-20 recorder
66 'Julie' operator's seat
67 ECM systems control panel
68 Cabin heater
69 Drift sight
70 Weapons bay door hydraulic jack
71 Weapons bay doors
72 Auxiliary fuel tank (2)
73 Parachute storage
74 Hydraulic oil reservoir
75 Wing centre-section carry-through
76 Roll stabiliser gyro
77 Front spar/fuselage main frame
78 Starboard wing inboard fuel tanks
79 Engine nacelle top fairings
80 Starboard engine nacelle
81 Exhaust duct
82 Engine cooling air exit louvre
83 Accessory equipment compartment
84 Exhaust-driven power recovery turbine
85 Wright R-3350-32W Turbo-Compound 18-cylinder two-row radial engine
86 Propeller reduction gearbox
87 Propeller hub pitch change mechanism
88 Spinner
89 Hamilton-Standard four-bladed variable-pitch propeller
90
91
92
93 Booster engine pylon
94 Underwing stores pylons (four)
95 Starboard outer wing panel fuel tanks
96 Starboard outer wing panel
97 Tip tank nose glazing
98 Remote-controlled searchlight
99 Starboard wing tip tank
100 Tank stabilising fin
101 Static discharger
102 Starboard aileron
103 Aileron hinge control
104 Aileron tab
105 Starboard spoilers, open
106 Flap jacks
107 Outboard single-slotted Fowler-type flap
108 Outer wing panel bolted joint
109 Flap guide rails
110 Inboard flap/engine nacelle beaver tail fairing
111 ARC-1 antenna
112 Centre electronics rack
113 Life raft
114 Emergency equipment
115 Rear spar/fuselage main frame
116 Radio operator's station
117 Radio rack
118 Cabin window/escape hatch
119 Water tank
120 Rear electrical distribution system
121 Rear cabin bulkhead
122 Dynamotor
123 Lower deck access steps
124 Oxygen bottles
125 Float light containers
126 Electronics equipment rack
127 HT-256/ARC antenna
128 Small sonobuoy stowage rack
129 Rear cabin skylight/escape hatch
130 Martin dorsal turret (P2V-7 and all earlier models)
131 Two 0.50in calibre machine-guns
132 Rear electronics equipment racks
133 Overhead sonobuoy stowage racks
134 Marine marker ejector
135 APA-69 antenna stowage
136 Observer's winow/escape hatch, port and starboard
137 Auxiliary electronics racks
138 Tailplane de-icing heater
139 Heater ram-air intake
140 Starboard tailplane
141 Starboard two-segment 'Varicam' elevator
142 Remote compass transceivers
143 Fin construction
144 Fin tip aerial fairing
145 ADF loop aerial
146 Anti-collision light
147 Static dischargers
148 Rudder tab
149 Rudder construction
150 Elevator and rudder hinge controls
151 Compensator loop cables
152 Magnetic anomaly detector
153 Tail navigation lights
154 Glassfibre MAD tail boom
155 Elevator tabs
156 Port two-segment elevator
157 'Varicam' elevator fore-section
158 Tailplane construction
159 Fin/tailplane attachment main frames
160 Tailplane leading-edge root fillet
161 Rear fuselage walkway
162 Tail bumper
163 AN/APR-9 antenna
164 Chemical toilet
165 Rear observer's seats (2)
166 AN/APA-69 antenna
167 Aft ventral radome
168 Camera viewfinder
169 Pneumatic reservoir
170 Camera flasher mount
171 ECM aerials
172 Sonobuoy release relay panel
173 Small sonobuoy rack
174 AT-256/ARC antenna
175 Sonobuoy launch tubes
176 Ladder
177 Oxygen bottles
178 Parachute stowage
179 Rear cabin ventral entry hatch
180 Large sonobuoy rack
181 Ventral Doppler aerial
182 Doppler electronics equipment rack
183 ALR-3 antenna
184 APR-26 aerials
185 Life raft
186 Emergency equipment stowage
187 Nacelle beaver tail fairing
188 Flap shroud ribs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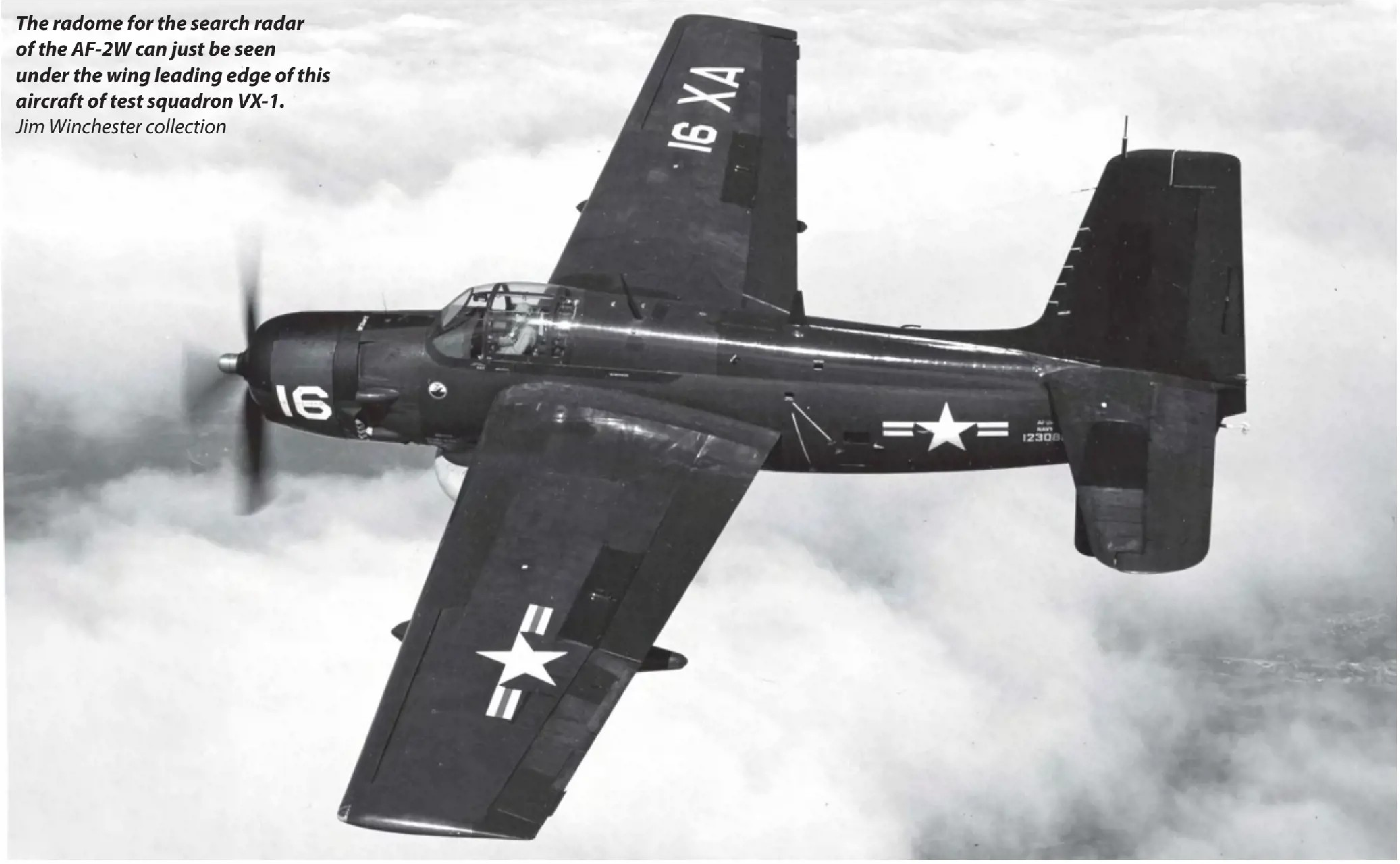
Mike Badrocke

189 Port single-slotted Fowler-style flaps
190 Port spoilers
191 Trailing-edge ribs
192 Port aileron construction
193 Aileron tab
194 Tip tank stabilising fin
195 Port wing fuel tip tank
196 Port navigation light
197 Tip tank nose fairing
198 Fuel filler cap
199 Outer wing panel rib construction
200 Lower wing skin/stringer construction
201 Leading-edge nose ribs
202 Leading-edge de-icing
203 Port wing stores pylons (four)
204 5in HVAR air-to-surface rockets
205 500lb mines or 325lb depth charges
206 Westinghouse J34-WE-36 booster turbojet engine
207 Engine accessory equipment
208 Booster engine cowling panels
209 Intake blanking doors, open
210 Engine pylon construction
211 Forward retracting port mainwheel
212 Port outer wing panel fuel tanks
213 Main undercarriage leg strut
214 Outer wing panel bolted joint
215 Inboard wing panel fuel tanks
216 Fuel tank access panels
217 Wing stringers
218 Fuel system feed tank
219 Propeller governor relay box
220 Port nacelle construction
221 Engine oil tank
222 Mainwheel doors
223 Engine bay fireproof bulkhead
224 Maintenance access panel
225 Engine bearer struts
226 Engine mounting ring frame
227 Oil cooler air flap
228 Twin oil coolers
229 Oil cooler air intake duct
230 Engine cooling air intake
231 Port spinner
232 Port engine cowling panels
233 Mk. 35 torpedo (2,165lb/982kg)
234 Mk. 55 mine (2,000lb/907kg)



The radome for the search radar of the AF-2W can just be seen under the wing leading edge of this aircraft of test squadron VX-1.
Jim Winchester collection

Grumman AF-2 Guardian

Hunter/Killer

The Guardian was developed as a replacement for the Avenger in the torpedo bomber role. By the time it flew, however, this mission was becoming obsolete, and it evolved into an ASW platform, split into two distinct airframes.

The Grumman XTB3F-1 made its maiden flight on 23 December 1946. It was a very large single-engined aircraft with a similar configuration to the Avenger, having a mid-wing layout allowing for a weapons bay underneath, rearwards folding wings and a large radial engine. Unlike the earlier Grumman, it had a two-man crew who sat side-by-side. An auxiliary jet engine was fitted in the fuselage, but this was never actually operated during testing and soon deleted.

Torpedo-bombing was becoming obsolescent in the face of heavier shipboard anti-aircraft defences, while submarines were the growing threat. The US Navy decided it wanted an ASW platform instead.

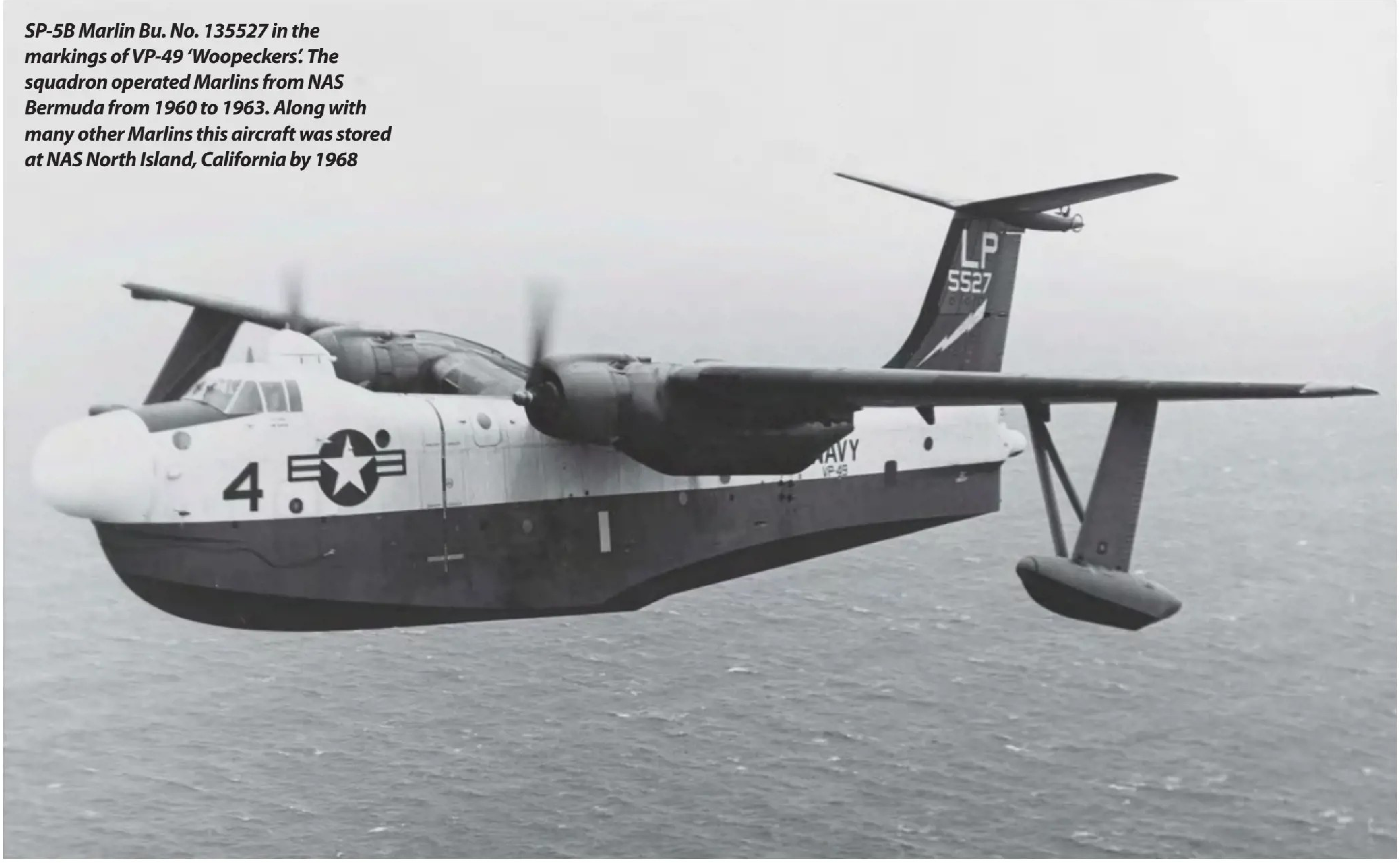
Even though it was the largest single-engined aircraft in the world at the time, there was no room to fit both a powerful search radar and a worthwhile weapons load into the same airframe, so some bright spark came up with the idea of splitting the task between two distinct variants. The AF-2W was the 'hunter', equipped with APS-120 radar in a large ventral radome, while the AF-2S was the 'killer', armed with depth charges, bombs or a torpedo and maybe underwing rockets for good measure. They would work in pairs; the AF-2W, nicknamed the 'Guppy' would find the surfaced submarine or periscope with its radar and sonar, and the AF-2S 'Scrapper' would attack, using its podded APS-30 radar or powerful searchlight to pinpoint the target.

The Guardian entered service in October 1950 and was mainly assigned to smaller anti-submarine carriers. It proved difficult to operate and had a high accident rate. Successful prosecution of an attack required careful coordination between the four men in the AF-2W and two in the -2S.

In 1955, the last fleet AF squadron, VS-37, swapped its Guardians for the twin-engined S2F Tracker, which could fulfil both the search and attack missions. Some Guardians remained in Naval Air Reserve service until 1957. A few had post-Navy careers as fire bombers.

Grumman AF-2S Guardian

Crew:	Two
Length:	43ft 4in (13.21m)
Wingspan:	60ft 8in (18.49m)
Height:	16ft 2in (4.93m)
Empty weight:	14,580lb (6,613kg)
Max T/O weight:	25,500lb (11,567kg)
Powerplants:	One Pratt and Whitney R-2800-48W radial engine rated at 2,400hp (1,791kW)
Max speed:	317mph (510km)
Service ceiling:	32,500ft (9,906m)
Range:	1,500 miles (2,414km)
Armament:	One 2,000lb torpedo or two 2,000lb bombs or two 1,600lb depth charges carried internally



SP-5B Marlin Bu. No. 135527 in the markings of VP-49 'Woopeckers'. The squadron operated Marlins from NAS Bermuda from 1960 to 1963. Along with many other Marlins this aircraft was stored at NAS North Island, California by 1968

Martin P5M Marlin

The last American Flying Boat

The gull-winged, T-tailed Marlin served the US Navy and Coast Guard at a time when land-based patrol aircraft could not match the range or endurance of large flying boats.

Design began in 1946 for a flying boat based on Martin's PBM Mariner patrol bomber, but incorporating a longer, narrower hull with a full-length planing bottom. Hydroflaps on the rear hull helped manoeuvring on the water. The gull wing raised the engines high above the surface and kept them clear of the spray generated on landing. The rear part of the engine nacelles served as bomb bays for conventional and nuclear depth charges.

Tests of the XP5M-1 began on 30 May 1948. It had a single conventional tail fin and gun turrets in the nose and tail. The first production P5M-1 flew at Baltimore on 22 June 1951. Instead of a gun turret in the nose it had a large radome for an APS-80 search radar and a raised flight deck. Deliveries to the US Navy, initially with VP-44, began in April 1952.

At least 80 P5M-1s were upgraded to P5M-1S standard with AN/ASQ-8 MAD equipment and 'Julie' active echo sounding and 'Jezebel' passive sonobuoy detection systems. After production of 107 P5M-1s, production switched to the P5M-2, which had a T-tail, a refined hull shape and more powerful R-3350 engines. The first of 131 P5M-2s flew in August 1953. The Marlin was operated by USN patrol seaplane squadrons VP-40, VP-44, VP-45, VP-48 and VP-50 from bases in the US and Bermuda and with the help of seaplane tender ships at sea..

A dozen USN Marlins were lost in fatal accidents, and others were written off in other mishaps. On 25 August 1959, a P-5M of VP-50 on a routine mission in bad weather suffered an engine fire and loss of electrical power, forcing the crew to ditch west of the Oregon-Washington border. The crew took to life rafts and were rescued by a Coast Guard Cutter, but a Mk. 90 'Betty' nuclear depth (minus its plutonium capsule) was lost at sea.

In May 1954 the USCG received the first of seven P5M-1Gs, which lacked ASW gear and weapons provisions. These were followed in 1956 by four P5M-2Gs, which were operated from Coast Guard stations at St. Petersburg, Florida and San Francisco, California.

The Marlins were complicated aircraft to operate and hard for the Coast Guard to maintain and were replaced in 1961 by Grumman HU-16 Albatross amphibians and returned to the Navy, which employed them as P5M-1T trainers. A 1964 experimental installation of a Pratt &. Whitney J60 jet engine in the tail of one Marlin as a means of boosting performance was to be followed by J85s on production aircraft, but the end of the flying boat era was approaching, and it was not proceeded with and nor was a four-engined P5M-3 development.

When the final P5M-2S was handed over in December 1960, it marked the final flying boat delivered to the US Navy, and the last complete aircraft built by Martin, which in future was to concentrate on missiles and spaceflight before merging with the American-Marietta Corporation in 1961, which in turn became part of Lockheed Martin in 1995.

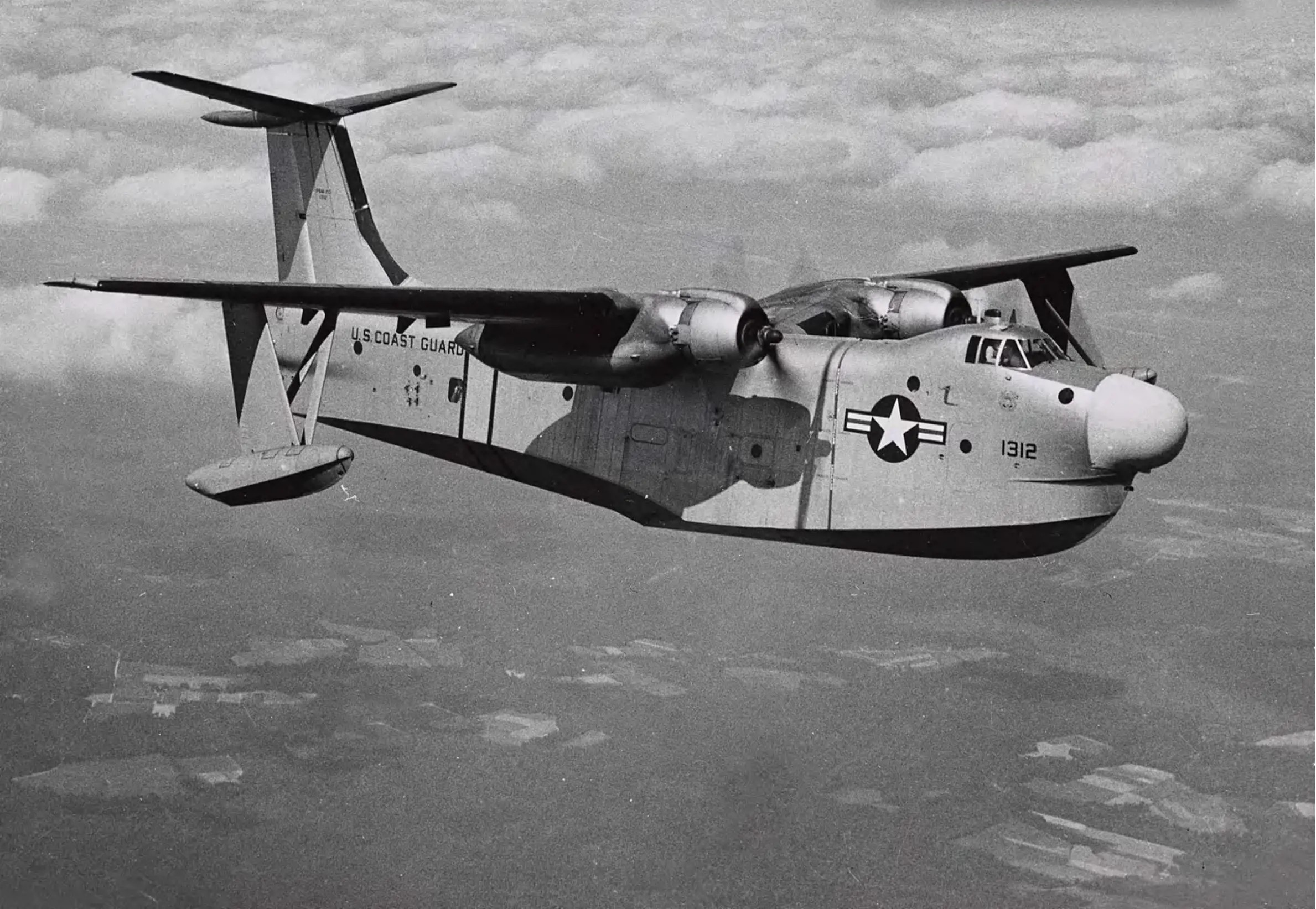
In 1962 the Marlin's base designation changed to P-5 and the P5M-2 became the SP-5B.

Marlins saw operational service in Vietnam during Operation Market Time, which was the US-South Vietnamese effort to prevent North Vietnamese infiltration of the South by water. The flying boats operated from the seaplane tenders USS Pine Island, Salisbury Sound, and Currituck off the South Vietnamese coast. The last Navy Marlin was retired in 1967 and later became part of the National Museum of Naval Aviation collection.

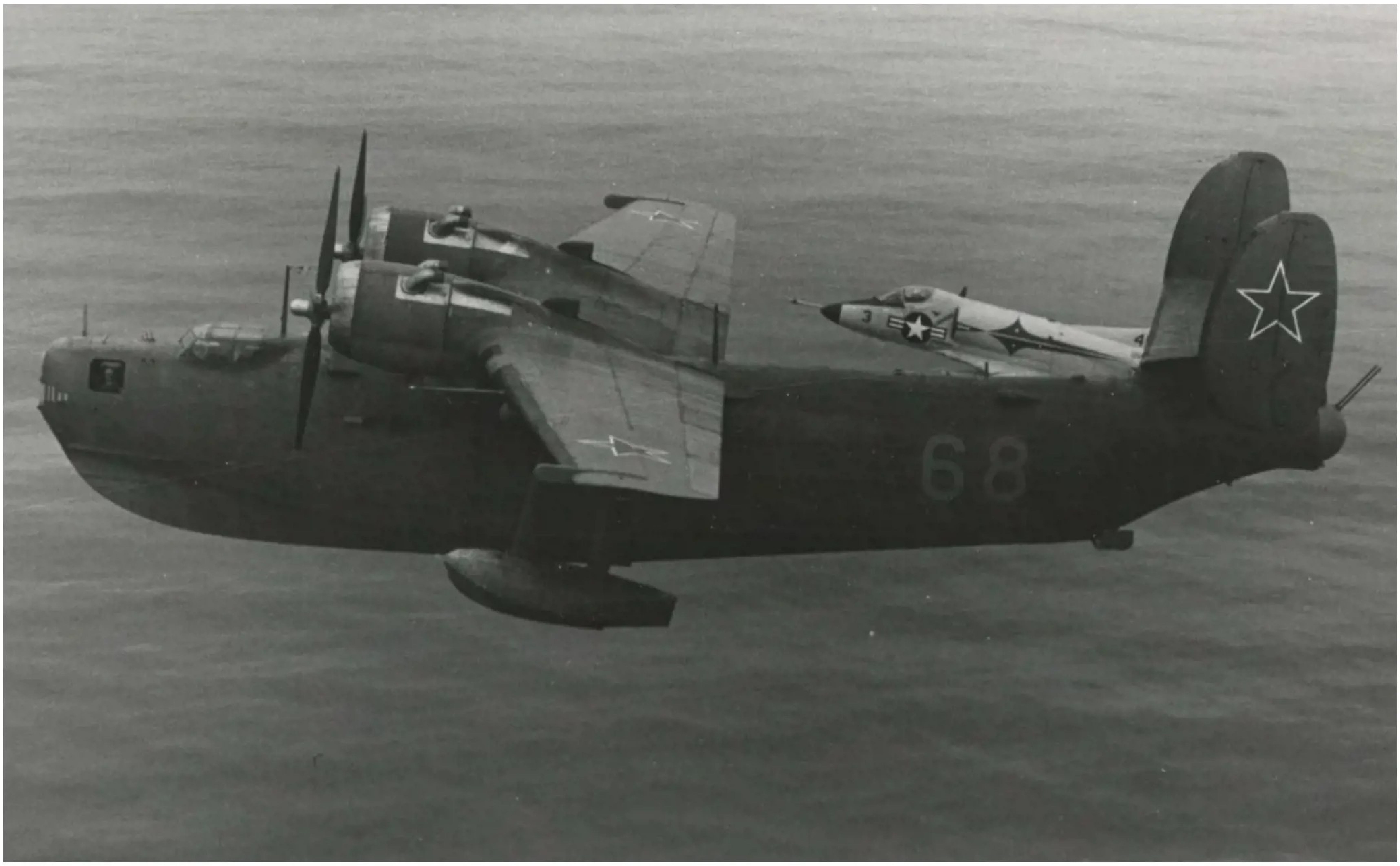
France's Aéronavale acquired ten P5M-2s, which were delivered between 1957 and 1959. These were deployed from Dakar in West Africa, but were returned to the US Navy by 1964 and the last French flying boat flotille, 27F, was disbanded.

P5M-2 Marlin

Crew:	11
Length:	100ft 7in (30.66m)
Wingspan:	118ft 2in (36.02m)
Height:	32ft 8in (9.97m)
Empty weight:	50,380lb (22,900kg)
Max T/O weight:	84,821lb (38,555kg)
Powerplants:	Two Wright R-3350-32W turbo-compound radial piston engines rated at 3,450hp (2,573kW) each
Max speed:	251mph (404km/h)
Service ceiling:	24,000ft (7,315m)
Range:	2,205 miles (3,300km)
Armament:	Four torpedoes or four 2,000lb bombs or mines, including Lulu or Betty nuclear depth charges carried internally; up to eight 1,000lb bombs or mines, or rockets carried externally



Below: ***The US Coast Guard operated the unarmed P5M-2G from February 1956. It was slightly longer than the -1G model with improved accommodation and a T-tail arrangement.*** *NARA*



Beriev Amphibians

Madge, Mail and Mermaid

The Beriev Design Bureau has been making flying boats and seaplanes since before World war Two and continues with the Altair jet, used for SAR and firefighting missions.

The Taganrog-based bureau produced the shipborne Be-2 reconnaissance floatplane in 1928 and the wartime Be-4 flying boat. It's first large aircraft, the Be-6 flying boat was based on the LL-3, first flown in 1945. Intended to replace lend-lease Catalinas and its license-built copy, the GST, production examples of the Be-6 were delivered from 1950.

Two 2,400hp (1,790kW) Shvetsov ASh-73 radial engines drove four-bladed propellers, giving a range of 2,975 miles (4,000km). It was heavily armed, with five 23mm Nudelmann NR-23 cannon in nose, tail and dorsal turrets. The dorsal turret was remotely operated. The Ilyushin-designed tail turret was replaced by a MAD stinger on later versions, and the nose turret by search radars.

The Be-6 was given the NATO reporting name Madge in the M for Miscellaneous category. It was relatively unknown outside of Russia, but occasionally encountered US carrier-based aircraft in the Pacific. By the 1970s they were mostly relegated to transport and unarmed fisheries patrol duties.

The even more obscure Be-10 Mallow was the company's first jet. Preceded by the experimental R-1 of 1953, the Be-10 had two AL-7PB turbojets mounted on the wing roots, a swept wing and fixed forward-firing cannon. Flying in June 1956 and entering service in 1961, it set several speed and altitude records in its (small) class.

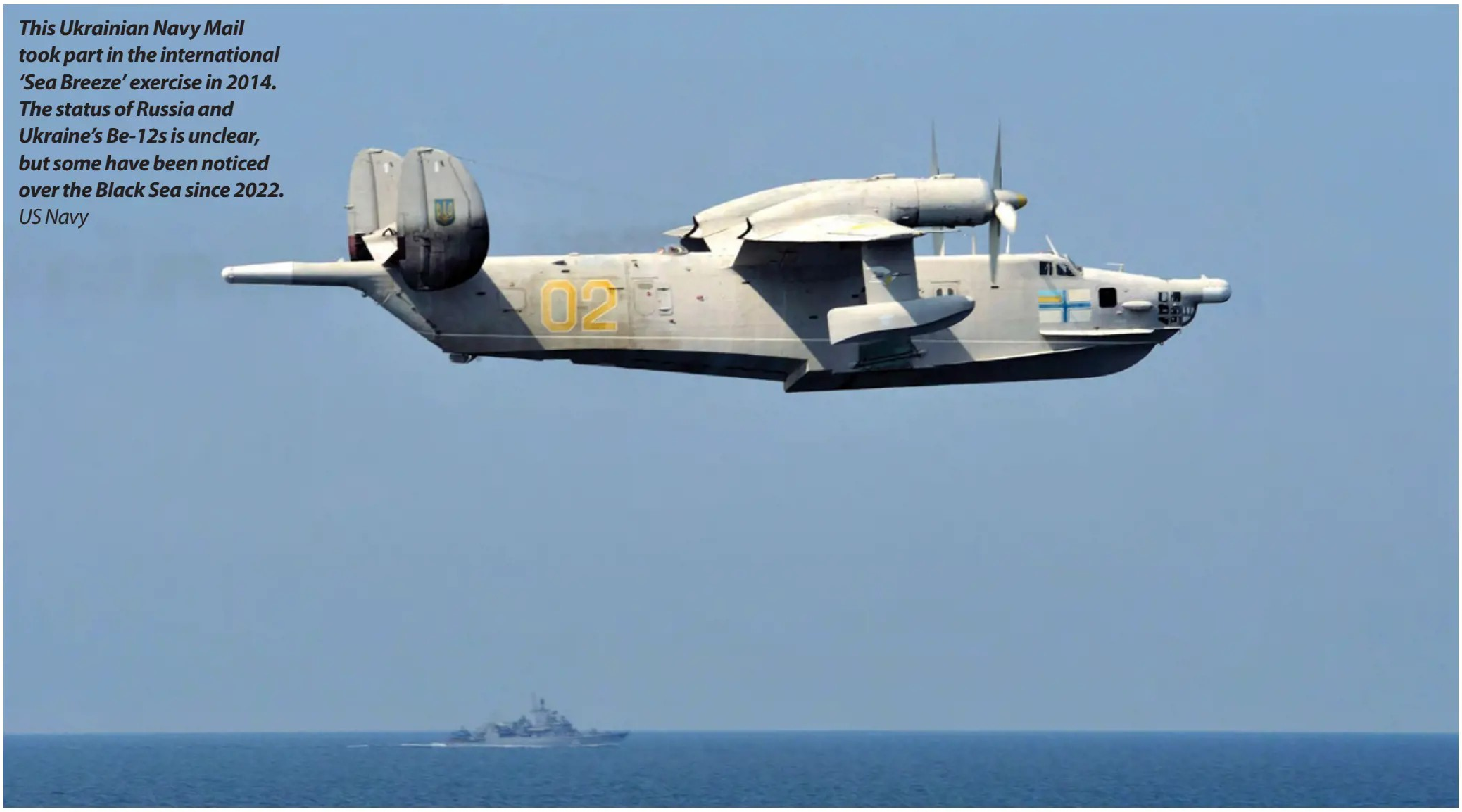
Only one unit, based on the Black Sea, was equipped with the Be-10 and it proved troublesome in service. The shoulder-mounted engines were prone to water ingestion; longer intake ducts reduced the performance and were not adopted. There were several crashes, some attributed to pitch-up on take-off, and its tactics of conventional bombing and torpedo attack were becoming obsolete. The type was phased out by 1963.

The Be-10 was replaced by another propeller-driven amphibian, the Be-12, named Tchaika

Above: ***This Pacific Fleet Be-6 was escorted by A-4B Skyhawks of the US Navy's VA-93 Det Q from the ASW carrier USS Bennington (CVS-20) in the mid-1960s.*** *Bob Krall via Jim Winchester*

Beriev Be 12 *Mail*

Crew: Five
Length: 99ft 0in (30.17m)
Wingspan: 97ft 6in (29.71m)
Height: 26ft 1in (7.94m)
Empty weight: 47,840lb (21,700kg)
Max **T/O weight:** 66,340lb (31,000kg)
Powerplants: Two Ivchencko AI-20D turboprops, each rated at 4,191hp (3,125kW)
Max speed: 380mph (610km/h)
Service ceiling: 37,000ft (11,300m)
Range: 4,660 miles (7,500km)
Armament: Up to (5,000kg) of bombs, rockets or ASMs on underwing pylons or depth charges and sonobuoys in fuselage bays



This Ukrainian Navy Mail took part in the international 'Sea Breeze' exercise in 2014. The status of Russia and Ukraine's Be-12s is unclear, but some have been noticed over the Black Sea since 2022. *US Navy*

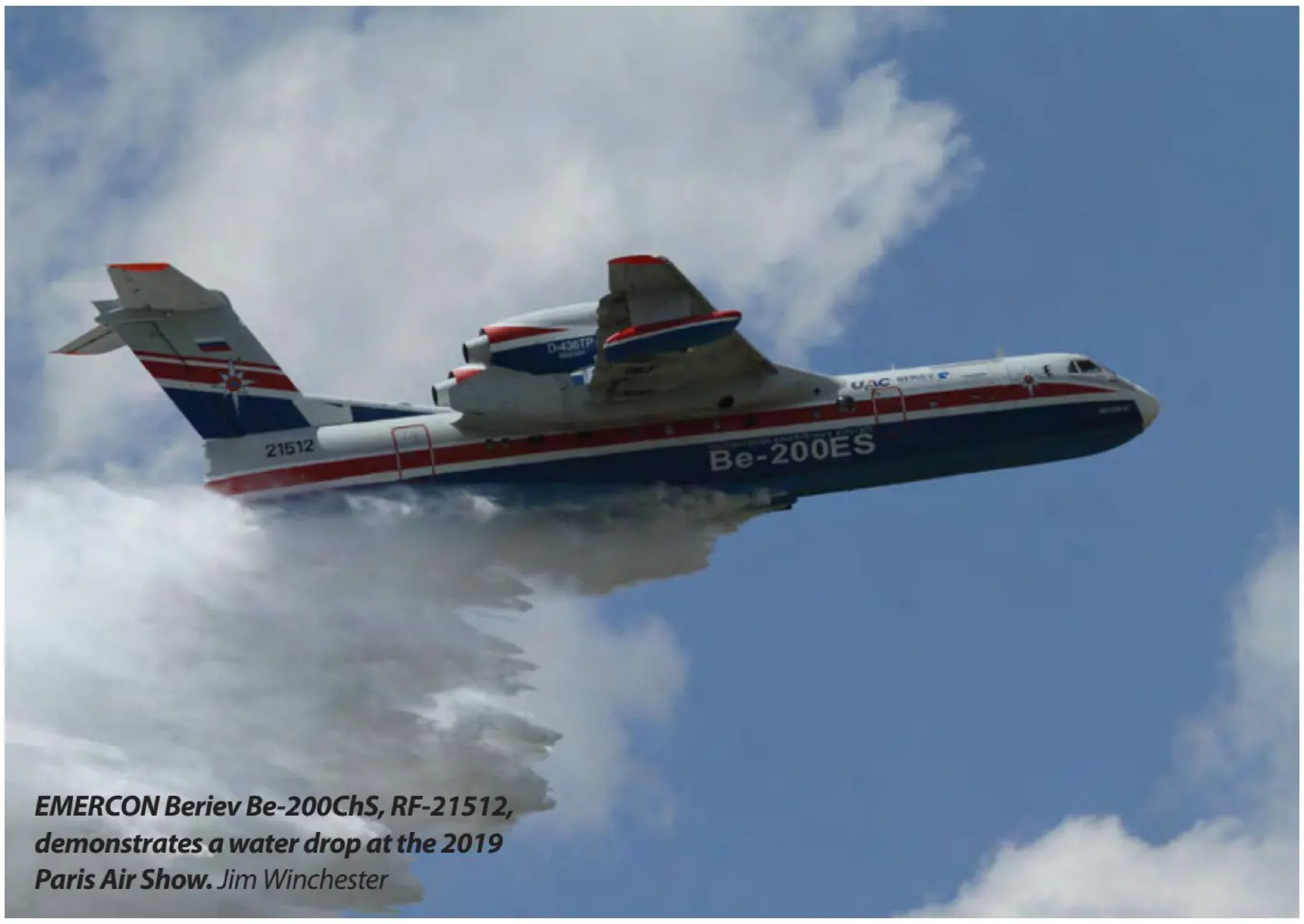
(seagull) for its gull-winged configuration that kept the engines clear of spray. Like the Be-6 it had a twin tail, but no defensive guns. The Be-12 (NATO: Mail) first flew at Taganrog on 18 October 1960 and was the most successful of the Beriev 'boats. A total of 140 production aircraft were built and issued to the Baltic, Black Sea, Northern, and Pacific Fleets.

Be-12s also flew in Egypt, Vietnam and Syria, apparently operated by Soviet crews. Ukraine inherited Be-12s when the USSR collapsed and reportedly had four operational in 2012. Surprisingly, Russia retained five in service and 24 in storage and the type has been seen over the Black Sea since the 2022 invasion of Ukraine, probably in a reconnaissance and targeting role. Some Russian Be-12s were modified as firefighting aircraft

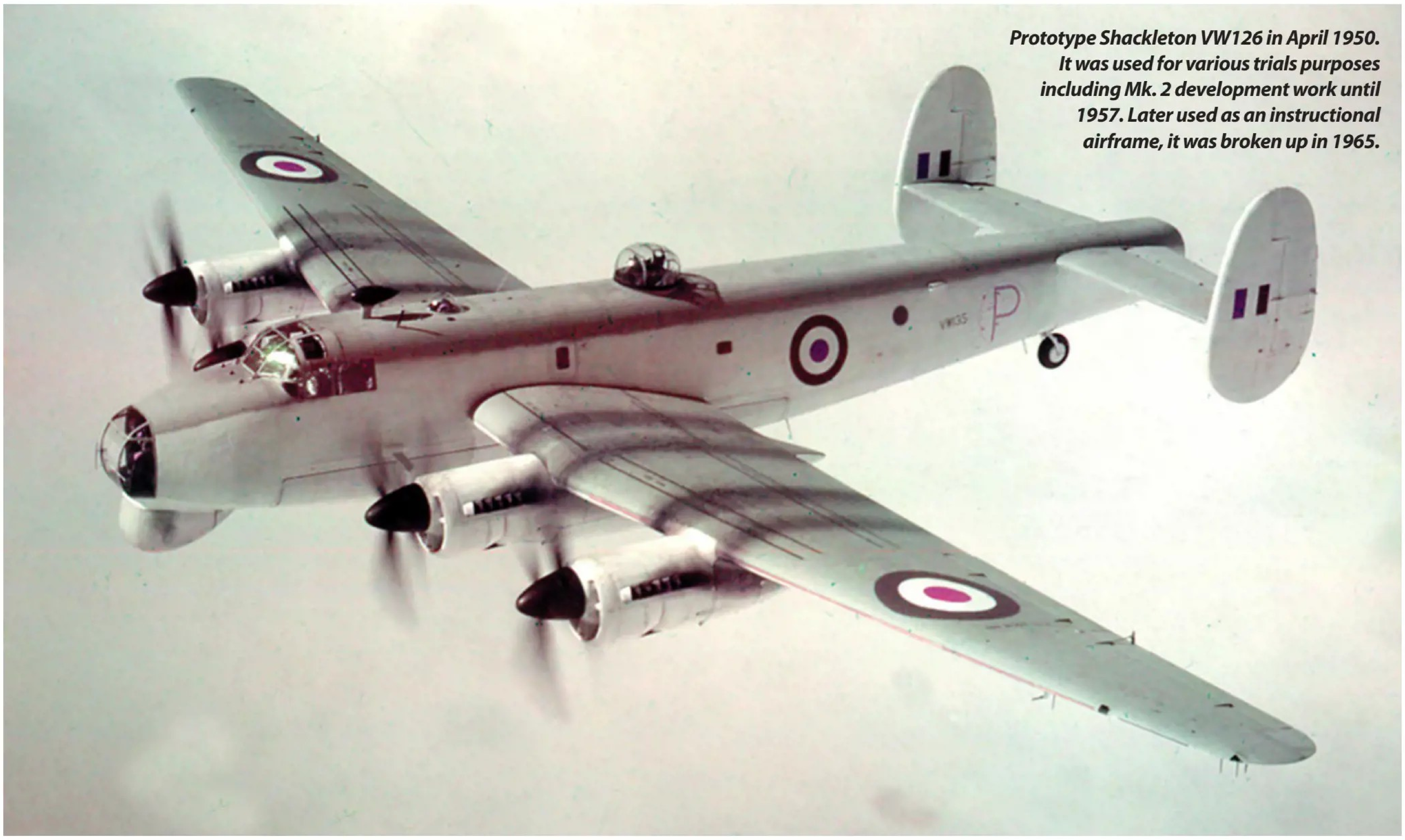
To replace the Be-12 and the land-based Il-38, a programme began in the early 1970s to develop a larger jet-powered amphibian. Beriev was tasked with developing the A-40 in late 1976, but it was ten years before a prototype rolled out of the factory, and finally flew (inadvertently during a taxy test) on 8 December 1986.

The A-40 was actually a four-engined aircraft, with two Solovyov D-30KPV turbofans of 26,455lb st (118kN) mounted on the rear fuselage and two 5,180lb st (23kN) Kolesov RD36-35 turbojet 'boost engines' inside their pylons. The intakes of the latter were covered by doors during water operations.

The A-40 received the designation Be-42, the name Albatross and the NATO reporting name Mermaid, but it never entered service. Development of a smaller version for civil firefighting continued, and this was completed as the Be-200 Altair. A first flight took place at Irkutsk on 24 September 1998 and the first production version was delivered in 2003 to the Russian Ministry of Emergency Situations (EMERCON). One more Be-200ChS and two Be-200PS were supplied to the Navy and assigned to SAR duties. Powered by two Progress D-346TP turbofans with 16,534lb st (73.55kN), the Be-200ChS can lift 26,000 (12,000kg) of water or retardant. With some difficulty, the Be-200ES-E variant achieved European civil certification in 2010, but this was suspended after the invasion of Ukraine. In August 2021, the Navy's Be-200ChS hit a mountainside while fighting forest fires in Turkey. All eight aboard died in the crash.



EMERCON Beriev Be-200ChS, RF-21512, demonstrates a water drop at the 2019 Paris Air Show. *Jim Winchester*



Prototype Shackleton VW126 in April 1950. It was used for various trials purposes including Mk. 2 development work until 1957. Later used as an instructional airframe, it was broken up in 1965.

Avro Shackleton

The Growler

The Shackleton served as the RAF's primary maritime patrol platform for two decades. Noisy and uncomfortable to fly in, it was nonetheless well regarded by its crews.

Development of a general reconnaissance variant of the Avro Lincoln bomber contemplated from late 1945 was formalised as Specification R.5/46, known within Avro as the Type 696. As design work progressed it deviated substantially from the Lincoln, incorporating parts of the Tudor airliner and new elements.

Three prototypes of the Shackleton GR.1 (later changed to MR.1) were ordered, with the first (VW126) flying from Woodford, Greater Manchester, on 9 March 1949 in the hands of the company's chief test pilot, Joseph Harold 'Jimmy' Orrell. Two other prototypes (VW131 and VW135) flew on 2 September 1949 and 29 March 1950, respectively.

Production MR.1s were built to Specification 42/46, with the first (VP254) flying on 24 October 1950. Only 29 Shackleton MR.1s were built, but they were followed by 46 MR.1As. The latter was powered by four Griffon 57As, while the original aircraft had Mk 57s in slimmer outboard nacelles and Mk 57As inboard.

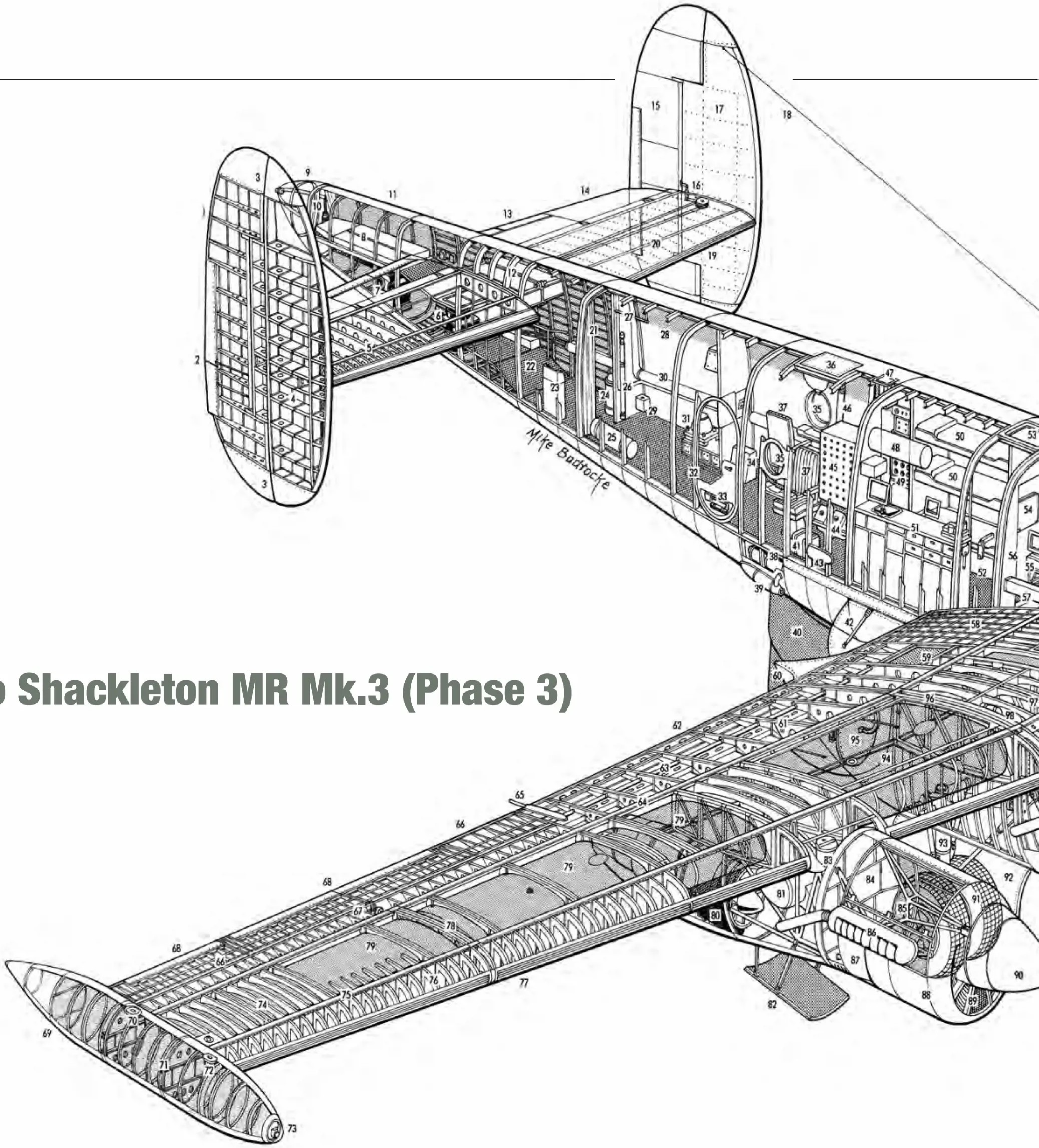
The Shackleton MR.1 entered service in March 1951 with 120 Squadron at Kinloss, Moray, although it moved to Aldergrove in Northern Ireland the next year. Other MR.1/1As were delivered in 1951 to No. 236 Operational Conversion Unit (OCU) and No. 220 Squadron at Kinloss (although the latter quickly moved to St Eval, Cornwall), plus No. 224 Squadron at Gibraltar. Nos 42 and 206 Squadrons re-equipped at St Eval during 1952, along with 240 at Aldergrove (moving to St Eval) and 269 Squadron at Gibraltar, before both settled at Ballykelly, Northern Ireland, later the same year.

Soon after entering service the cannons and machine-guns fitted in the nose and tail were removed, although the mid-upper Bristol B17 turret was retained. The aircraft's radar, mounted under the nose, was also found to be ineffective. Work on an improved version had already been authorised before the MR.1 had flown. What would become the MR.2 featured lengthened nose and tail sections; a redesigned tailplane; a strengthened landing gear with a retractable, two-wheel tail unit; and an ASV Mk.13 radar within a retractable radome installed aft of the bomb bay. The original Shackleton prototype was modified to the MR.2's aerodynamic configuration, flying as such on 19 July 1951, while a MR.1A airframe (WB833) was completed on the production line as the 'true' prototype for the variant, completing its maiden flight on 17 June 1952.

Between September 1952 and August 1954 a total of 69 production Shackleton MR.2s were delivered to the RAF. The first for an operational unit went to 42 Squadron at St Eval in January 1953. Other squadrons that converted to, or augmented its MR.1As with MR.2s during 1953, were 37 and 38 at Luqa, Malta, and 120, 220, 224, 240 and 269 Squadrons in the British Isles, followed by 204 and 228 Squadrons the next year.

In addition to flying endless patrols over the world's oceans, Shackletons were also used in other roles. During 1955 they ferried British troops to Cyprus, a role they also performed during the Suez War in October-November 1956. They served as bombers during the Oman War in 1957 and 1958 and served a similar role in Aden for colonial policing duties.

Between 1956 and 1961 17 MR.1As became Shackleton T.4 trainers for the Maritime Training Unit (MOTU), formed on 1 October 1956 to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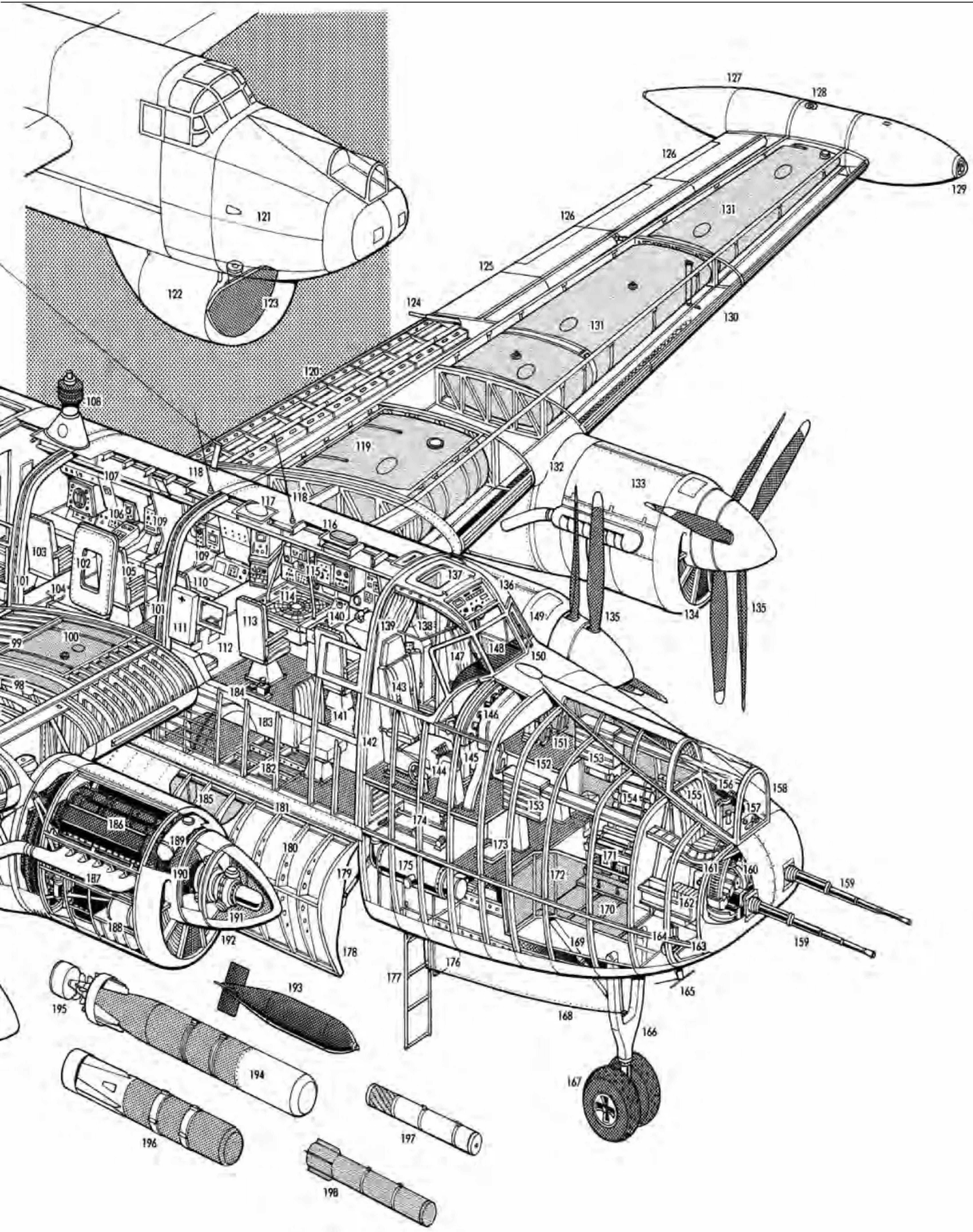
Avro Shackleton MR Mk.3 (Phase 3)

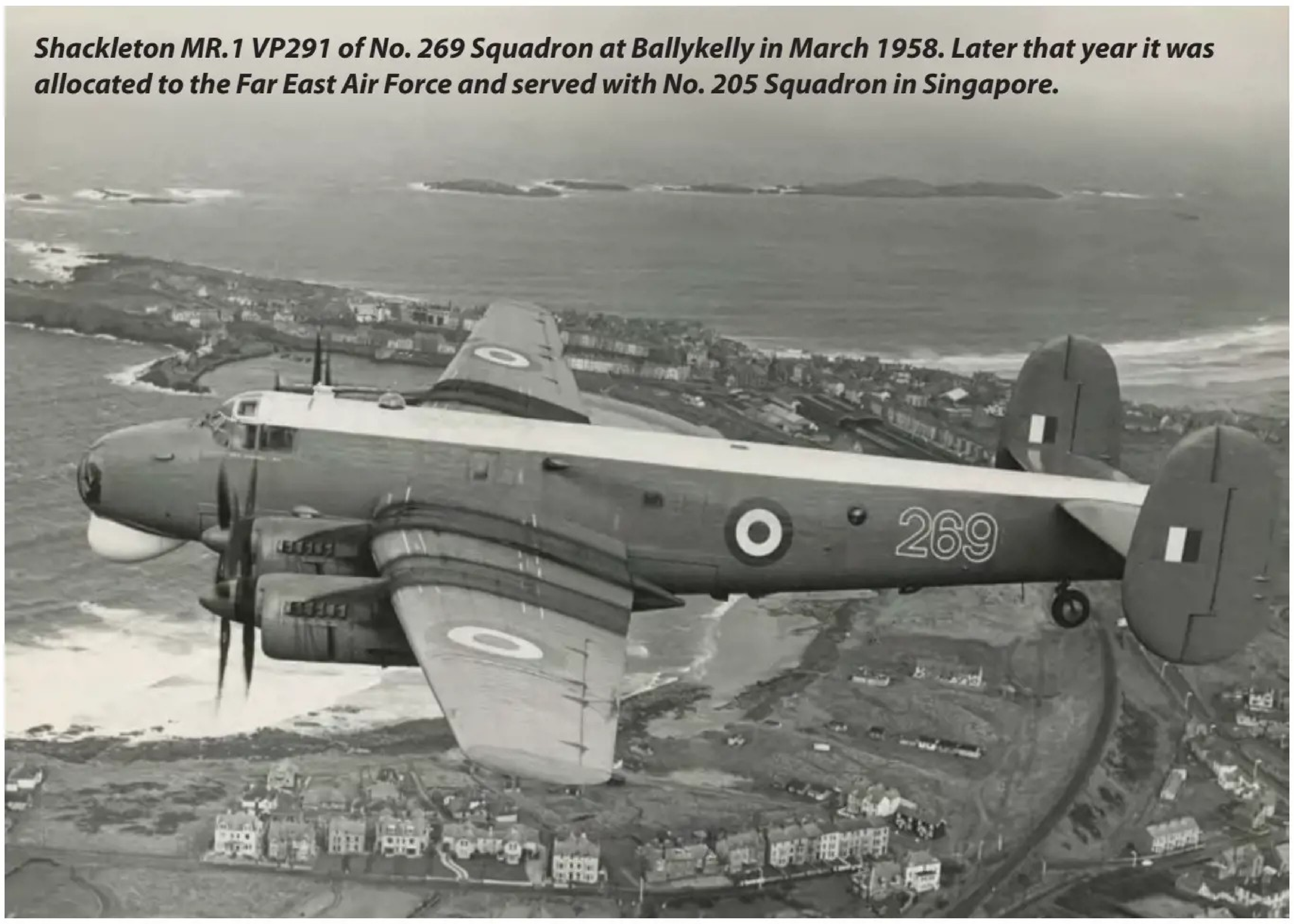
1 Starboard rudder construction
2 Rudder tabs
3 Rudder horn balance
4 Fin construction
5 Starboard tailplane construction
6 Reconnaissance camera
7 Strike camera
8 Rear observer's couch
9 Tail cone observation window
10 Astro compass
11 Fuselage tail cone
12 Tailplane centre section joint
13 Elevator tabs
14 Port Elevator
15 Port Rudder
16 Rudder cable control
17 Port fin
18 HF aerial cable
19 Tailplane leading edge de-icing
20 Port tailplane
21 Rear cabin curtained bulkhead
22 Tail cone access decking
23 Water tank
24 Toilet
25 Emergency equipment pack
26 Bomb bay periscope
27 Coat rail
28 Cabin wall trim panelling
29 First air kit
30 Control cable ducting
31 Blue Silk radar equipment
32 Rear entry door
33 Emergency equipment stowage
34 Flame float ejector
35 Observation windows, port
36 Rear cabin escape hatch
37 Observer's seats, port and starboard
38 Sear cabin heater
39 Heat exchanger air intake
40 Ventral 'dustbin' radome, extended
41 Dinghy stowage
42 Bomb bay door hydraulic jack
43 Flare discharge chute
44 Flare dischargers
45 Flare stowage rack
46 Ventral radome extending hydraulic jack (x2)
47Photoflash discharger
48 Freshwater tank
49 Pyrotechnic stowage rack
50 Crew rest bunks
51 Galley unit
52 Crew rest area
53 Cabin roof escape hatch
54 Folding table
55 Aft facing seat
56 Operational Cabin rear bulkhead
57 Dinghy and parachute stowage
58 Wing trailing edge rib constructions
59 Life raft stowage
60 Inboard nacelle tail fairing
61 Flap shroud ribs
61 Split trailing-edge
62 Fap shroud ribs
63 Flap-operating shaft
64 Rear spar
65 Four-segment aileron
67 Aileron hinge link
68 Aileron tabs
69 Starboard fixed tiptank
70 Fuel filter cap
71 Tiptank rib construction



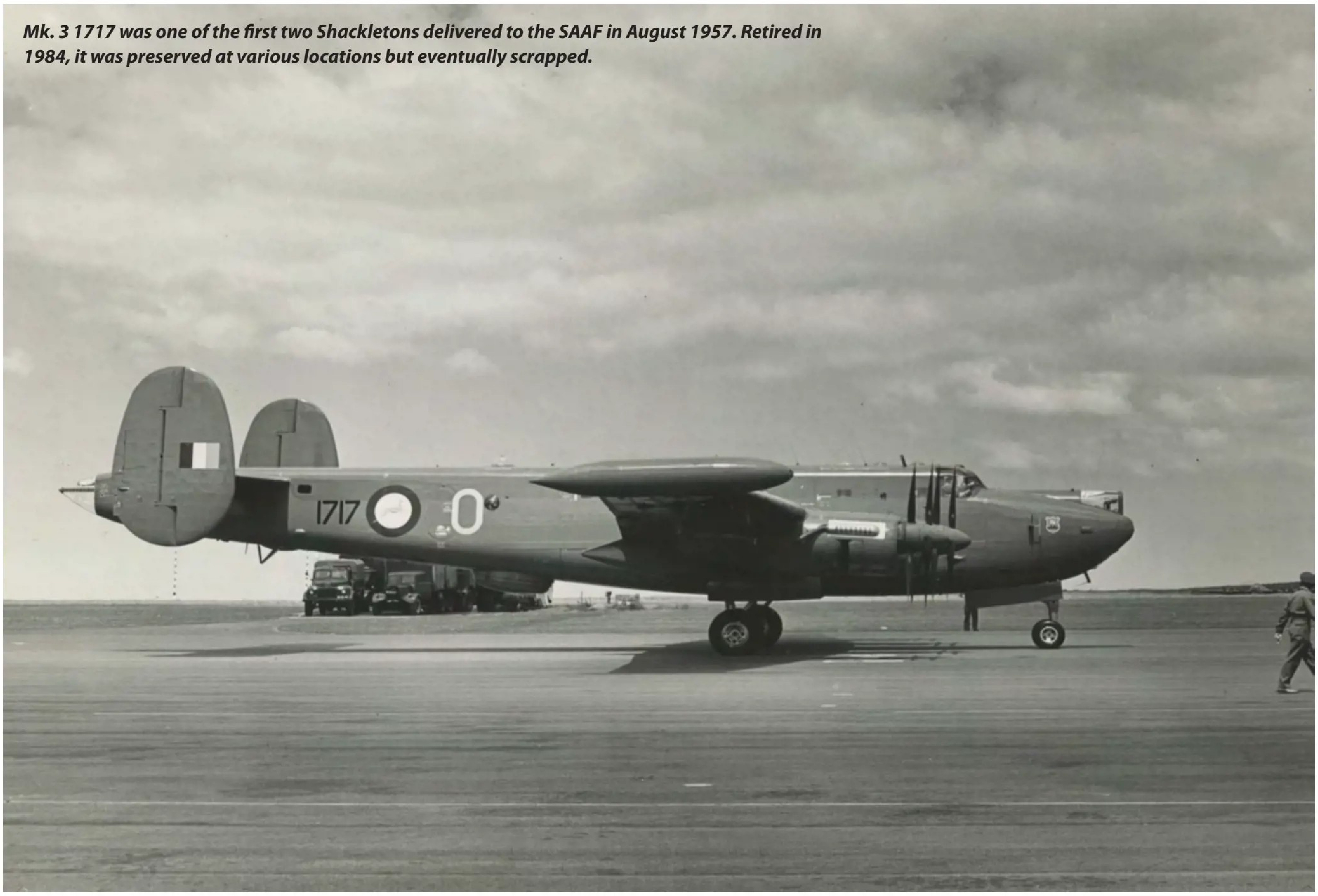
72 Pressure relief valve
73 Staboard navigation light
74 Wing rib construction
75 Front spar
76 Leading-edge nose ribs
77 Leading-edge de-icing strips
78 Wingtip panel joint rib
79 Port outer fuel tanks; total internal fuel capacity 3,316 gal
80 Rolls-Royce (Bristol-Siddeley) Viper 203 boost engine (Phase 3 aircraft only)
81 Water-methanol tank
82 Book engine air intake open
83 Hydraulic reservoir
84 Engine bay fireproof bulkhead
85 Engine bearer struts
86 Exhaust muffler
87 Radiator air outlet duct
88 Engine cowling panels
89 Oil and coolant radiators
90 Spinner
91 Forward retracting twin mainwheels
92 mainwheel doors
93 Main undercarriage legs
94 Intermediate fuel tank
95 SASV Mk.21 search radar scanner
96 Outer wing panel joint rib
97 Main undercarriage wheel bay
98 Engine mounting ribs
99 Fuel tank bay access panel
100 Inboard fuel tank
101 Wing/fuselage attachment main frames
102 Ditching hatch port and starboard
103 Secondary sonics operator's seat
104 Rear spar centre section carry-through housing
105 ASV operator's seat
106 ASV instrument displays
107 Overhead handrail
108 ARI 18144 ECM serial
109 Sonics equipment racks
110 Master sonic station
111 First-aid kit
112 Front spar centre section carry-through housing
113 Attack navigator's seat
114 Plotting table
115 Instrument displays
116 DF Loop aerial
117 Astrodome observation hatch
118 VHF aerials
119 Port wing inboard fuel tank
120 Port spilt trailing-edge flap
121 Shackleton AEW Mk.2 nose profile
122 Radome for early warning radar
123 AN/APS 20 radar scanner
124 Fuel jettison pipe
125 Port four segment aileron
126 Aileron tabs
127 Port tiptank
128 Fuel filler cap
129 Port navigation light
130 Wing leading-edge de-icing
131 Port outer wing fuel tanks
132 Outboard engine nacelle
133 Detachable cowling panels
134 Oil and coolant radiator intakes
135 de Havilland six bladed constant speed contra-rotating propellor
136 Frameless cockpit canopy cover
137 Cockpit roof escape hatch
138 Port side signaller's station
139 Folding sunblind
140 Tactical navigator's station
141 Flight engineer's station
142 Cockpit bulkhead
143 Copilot's seat
144 Engine throttle and propellor control levers
145 Control column
146 Instrument panel
147 Pilot's seat
148 Instrument panel shroud
149 Windscreen panels
150 Windscreen wipers
151 Rudder pedals
152 Cockpit floor level
153 Ammunition tanks, port and starboard
154 Pyrotechnic stores racks
155 Airgunner's seat
156 Gunsight
157 Gun control panel
158 Optically flat gunner's windscreen
159 20-turn cannon (Phase 2 aircraft only, deleted on phase 3)
160 Gun -swivelling and -elevating mechanism
161 Ammunition feed chutes
162 Ballast weights
163 Ventral air bomber's observation window
164 Bombsight
165 Radio homing aerial
166 Nose undercarriage leg strut
167 Twin nosewheels
168 Nosewheel doors
169 Hydraulic retraction strut
170 Air bomber's prone-position couch
171 Forward radio rack
172 Starboard side electrical equipment rack
173 Windscreen spray and humidity system water tank
174 Underfloor control runs
175 Forward cabin heater
176 Ventral entry hatch
177 Boarding ladder
178 Bomb bay door
179 Bomb Bay door hydraulic jack
180 Door frame construction
181 Bomb door hinge beam
182 Cabin floor beam construction
183 Cable duct
184 Drift recorder
185 Bomb bay overload fuel tank, 400 gal
186 Rolls Royce Griffon 57A V12 engine (Phase 2 aircraft; Griffon 58 in Phase 3 aircraft)
187 Exhaust collector
188 Oil and coolant radiators
189 Engine oil tank
190 Propeller reduction gearbox
191 Propeller hub pitch-change mechanism
192 Spinner
193 1,000lb high-explosive (HE) bomb
194 Mk.30 torpedo
195 Torpedo parachute container
196 Mk.11 depth charge
197 Smoke marker
198 Parachute flare

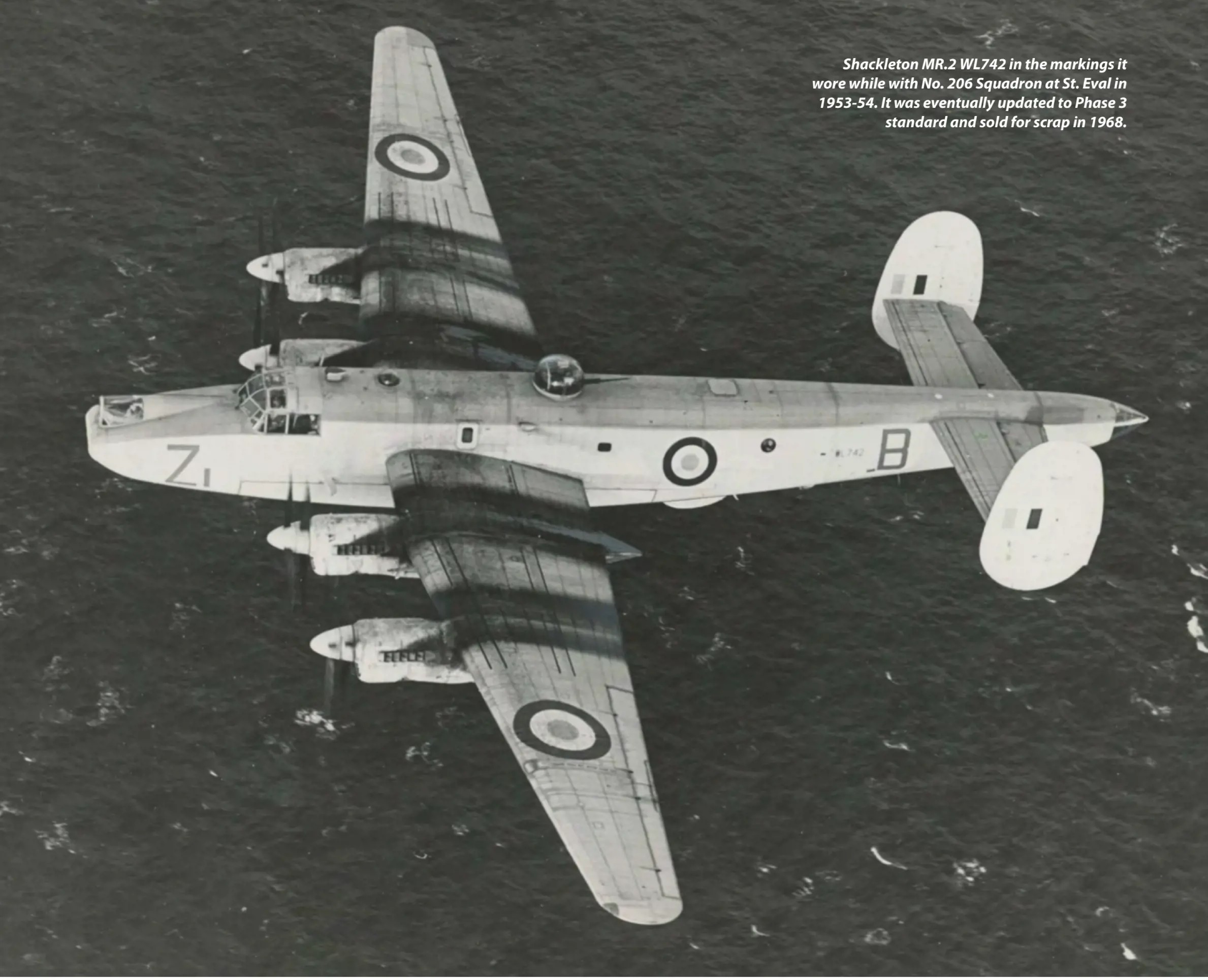
replace 236 OCU. As MR.2s displaced MR.1As within Coastal Command it allowed 205 Squadron at Changi in Singapore to replace its Short Sunderlands from May 1958 with the earlier model. The unit later played a role in the Confrontation with Indonesia from the end of 1962 until August 1966, patrolling the waters off to prevent the infiltration of Indonesian forces operating against Malaysia.

During May and June 1953 four Shackleton MR.2s of 42 Squadron visited South Africa. At the time, the South African Air Force (SAAF) was looking to replace its Sunderlands operated by 35 Squadron at Congella near Durban. An order for eight was announced in January 1954, equipped not only for maritime reconnaissance but also as bombers. Rocket rails were installed under the wings and they were to be capable of carrying an airborne lifeboat for air-sea rescue. The order was partly responsible for a redesign of the aircraft that resulted in the Shackleton MR.3, which introduced a tricycle landing gear to improve crosswind landing performance, a stronger main landing gear with dual wheels, wingtip fuel tanks, a clear vision cockpit canopy and revised equipment and crew facilities.


Shackleton MR.1 VP291 of No. 269 Squadron at Ballykelly in March 1958. Later that year it was allocated to the Far East Air Force and served with No. 205 Squadron in Singapore.

The Shackleton MR.3 prototype first flew on 2 September 1955, but crashed after stalling on 7 December 1956, with the loss of Avro test pilot Jack Wales. The RAF ordered 52, but this was reduced to 33 (plus a replacement for the prototype) in 1956. The Shackleton MR.3 first entered service with 220 Squadron, at St Eval during August 1957.


Mk. 3 1717 was one of the first two Shackletons delivered to the SAAF in August 1957. Retired in 1984, it was preserved at various locations but eventually scrapped.



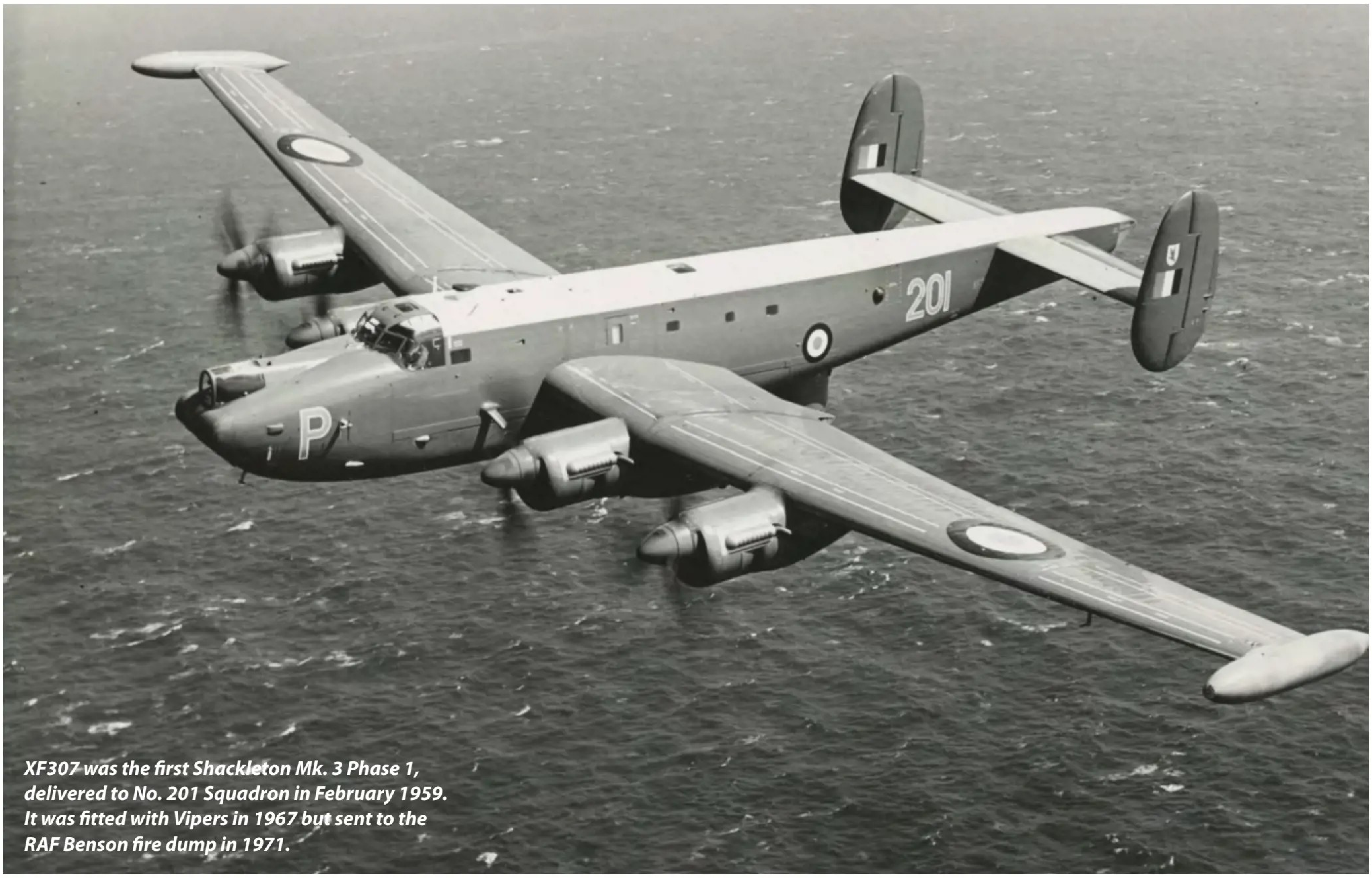
Shackleton MR.2 WL742 in the markings it wore while with No. 206 Squadron at St. Eval in 1953-54. It was eventually updated to Phase 3 standard and sold for scrap in 1968.

Both the MR.3s and 2s underwent successive upgrades in RAF service, which were known as 'Phases'. Phase 1 mainly concerned internal equipment changes (with MR.2s modified becoming MR.2cs), while Phase 2 added Orange Harvest electronic support measures (with an antenna reminiscent of a 'spark plug' added on the upper fuselage), electronic countermeasures and a better high frequency radio. Phase 3 introduced new navigational equipment and altered the internal configuration of the aircraft.

Adding new equipment to the Shackleton MR.3 pushed up its weight, making its take-off performance marginal. The solution was to add a pair of Armstrong Siddeley Viper turbojets in the outboard engine nacelles, which would be used for around two minutes to acceleration for take-off. The installation required the wing spar to be strengthened, but was incorporated as part of the Phase 3 upgrade for the MR.3 only.

South Africa was the only export customer for the Shackleton. Part of D. F. Malan Airport in Cape Town was allocated to house the SAAF's fleet, the first two of which were handed over on 21 May 1957, after a team from No. 35 Squadron had trained at Woodford from February. After participating in a joint exercise with American, British and Dutch forces in the North Atlantic, the initial three departed for South Africa, two arriving at Waterkloof air base on 18 August 1957 and the third the next day, before they flew onto Cape Town. The final three of the eight Shackletons arrived in late February 1958, allowing 35 Squadron to become operational on the aircraft.

They were primarily used to fly patrols along the coastline of South Africa and Namibia, hunting for submarines or surface vessels. They also participated in many SAR operations, notably in October 1965 when they joined the search for the crew of a SAAF Blackburn Buccaneer that had come down in the Atlantic on its delivery flight. One of the Shackletons was able to locate the survivors in a dinghy, allowing them to be picked up by a ship. The only loss in service occurred on 8 August 1963, when all 13 onboard 1713 were killed after the aircraft crashed in the Steynskloof Mountains during poor weather conditions. The



XF307 was the first Shackleton Mk. 3 Phase 1, delivered to No. 201 Squadron in February 1959. It was fitted with Vipers in 1967 but sent to the RAF Benson fire dump in 1971.

remaining seven were later slowly upgraded to Phase 3 standard, but without receiving the Viper engines. This was fortunate, as the stress of the using auxiliary engines helped shorten the careers of the RAF's MR.3s.

At the end of 1970 Shackleton MR.3s were retired by 220, 206 and 120 Squadrons, leaving 42 and 203 Squadrons flying the variant until September 1971 and January 1972, respectively.

The last unit fully-equipped with Shackleton MR.2s was No. 204 Squadron, which ceased maritime operations with the 'growler' at Ballykelly at the end of March 1971. The following day it became operational at Honington, having reformed from the Majunga Detachment Support Unit, which had been created at the start of March 1971 to provide five Shackleton MR.2cs for the Beira patrol, the blockade of oil shipments to Rhodesia. It operated from Majunga in Madagascar, as well as Masirah, Oman, and Tengah in Singapore. The squadron disbanded on 28 April 1972.

The last RAF unit to receive MR.2s was No. 8 Squadron. From 1971 a total of 12 MR.2s were fitted with AN/APS-20 radars salvaged from Fairey Gannet AEW.3s as Shackleton AEW.2s, providing the RAF with an 'interim' airborne early warning capability. A few MR.2s were used by the squadron for a few months when it reformed on 8 January 1972 at Kinloss (before moving to Lossiemouth), as the AEW.2s entered service. The last Shackleton AEW.2 was only retired on 1 July 1991.

In March 1971 SAAF Shackletons dispatched the Wafra with depth charges after its Buccaneers had failed to sink the damaged tanker. No. 35 Squadron's aircraft monitored refugees entering Namibia from the war in Angola in 1975, dropping supplies when needed.

Two aircraft, 1716 and 1717 were resparred in 1973-77. By then relations with the UK had broken down, resulting in much of work on 1716 being completed locally, while spares for the aircraft became difficult to acquire as the arms embargo on South Africa began to bite. Over the years that followed the size of the fleet decreased, with the last three in service (1716, 1721 and 1722) retired on 23 November 1984.

This was not quite the end of the story, however, as during the early 1990s 1716 was restored to airworthy condition to appear at air shows in the UK. Unfortunately it came down in the Western Sahara desert on 13 July 1994 on its way to Europe. In its place work was undertaken on 1722, allowing the aircraft to return to the skies on 18 February 1995. It is understood to have made the final flight by a Shackleton on 29 March 2008.

Avro Shackleton MR.3

Crew:	Ten typical (two pilots, two navigators, flight engineer, air electronics officer and four air electronics operator)
Length:	92ft 6in (28.19m)
Wingspan:	119ft 10in (36.53m)
Height:	23ft 4in (7.11m)
Empty weight:	57,800lb (26,218kg)
Max T/O weight:	108,000lb (48,988kg) in Phase 3
Powerplant:	Four Rolls-Royce Griffon Mk 57A piston engines of 1,960hp (1,460kW). Phase 3 added two Armstrong Siddeley Viper 11 Mk 203 turbojets of 2,700lb st (12kN)
Max speed:	302mph (486km/h)
Range:	4,215 miles (6,783km)
Service ceiling:	19,200ft (5,852m)
Armament:	Two 20mm Hispano Mk V cannon in nose, plus up to 10,000lb (4,536kg) of bombs, torpedoes, mines or conventional or nuclear depth charges in bomb bay

The Gannet AS.1s of No. 812 NAS, assigned to HMS Bulwark circa 1955. The Gannet had a short career as a sub hunter with the Royal Navy (1954-60), but continued in other roles.

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ROYAL NAVY

Fairey Gannet

Britain's Naval Sub-hunter

The Fairey Gannet was destined to be the Royal Navy's last fixed-wing ASW platform before the role passed to suitably equipped helicopters. Although it had a relatively brief career with the Fleet Air Arm (FAA) as an anti-submarine platform, it remained active overseas into the early 1970s.

The Gannet was conceived as the Fairey Q to be powered by the Rolls-Royce Tweed double propeller turbine, but work on the powerplant ceased and the manufacturer instead approached Armstrong Siddeley for a replacement. That company coupled two Mamba ASM.3 turbines together with a common gearbox turning contra-rotating, co-axial propellers, to create the Double Mamba. The powerplant was incorporated in the design Fairey submitted to meet Speciation GR.17/45, which called for a two-seat carrier-based aircraft able to undertake both the anti-submarine and strike roles.

On 12 August 1946 a contract for two prototypes of the Fairey 17 – the number derived from the specification – was received, while Blackburn was commissioned to produce three B.54s (YA.5s) powered by the Napier Naiad. After the Naiad was cancelled, Blackburn redesigned its aircraft as the B.88 (YB.1) with a Double Mamba, although the first two airframes were completed as B.54s with the Rolls-Royce Griffin 56, as the YA.7 and YA.8. By the time the YA.7 had flown on 20 September 1949, the Admiralty wanted it to carry an air-to-surface radar, plus a third crew member to man it. These changes resulted in the YA.8, which flew on 3 May 1950, which was used as the basis for the Double Mamba-powered YB.1.

The rival Fairey 17 prototype completed its maiden flight the day before the YA.7. Chief Test Pilot Group Captain Richard Gordon Slade lifted VR546 off from Aldermaston, Berkshire, the first flight by an aircraft with a double propeller-turbine powerplant. Each half of the engine was controlled independently and could be shut down in flight, increasing endurance and range. Although stability and control issues hampered development, VR546 alighted on HMS Illustrious on 19 June 1950, the first carrier landing by a propeller-turbine aircraft.

The second prototype (VR557) flew on 6 July 1950. While the first performed aerodynamic testing, the second was tasked with systems development; as such, it had much more of the equipment expected to be carried. Both prototypes were configured for just a pilot and observer. To demonstrate the aircraft ability to carry a third person VR546 had its mocked-up retractable ventral radome moved further aft by mid-March 1951. An external wooden mock-up of a rear canopy was installed behind the wing trailing edge, so that its aerodynamic properties could be investigated in the air. The new canopy caused problems with the airflow over the tail surfaces, which was alleviated by adding small finlets on the horizontal tail surfaces, plus a larger vertical tailplane.

A third, fully compliant prototype (WE488) that had been ordered in June 1949 to satisfy the revisions to the original specification, joined the test programme on 10 May 1951. By then, the Fairey 17 had become the Gannet, while work on the YB.1 had ended.

Fairey received an initial order for 100 Gannet AS.1s on 14 March 1951 to fulfil Specification GR.117P. A desperate need to improve the Royal Navy's anti-submarine capabilities meant the Gannet became a 'super priority' programme, streamlining the supply of material and funding to get the aircraft into service quickly. Even so, it would take more than two years before the first production aircraft (WN339) flew.

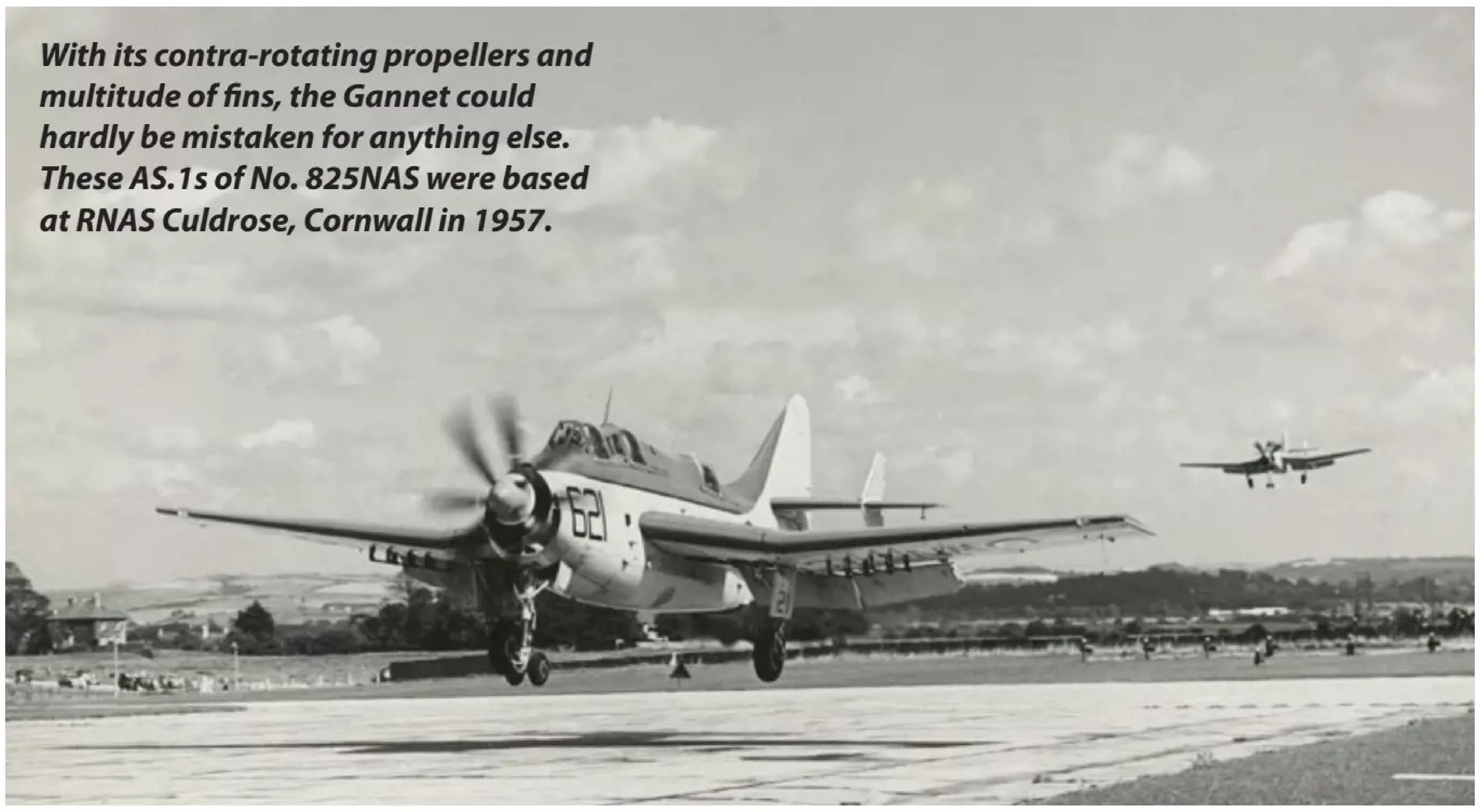
Production Gannets built at Hayes were transported to Northolt, Middlesex, where they were reassembled prior to flying. Peter Twiss was at the controls of WN339 for its maiden flight on 9 June 1953, landing at Fairey's facility at White Waltham, Berkshire, where most of the production testing was undertaken.

The urgent need for Gannets meant a second assembly line was established. Gannet AS.1 WN370 became the first built at the Fairey plant at Heaton Chapel in Stockport, Manchester; it was delivered on 28 September 1954. Aircraft built at Stockport were flight tested at Ringway before being delivered. A total of 181 Gannet AS.1s were built (including export aircraft, but not the T.2 prototype), 54 at Stockport, the rest at Hayes.

Gannet AS.1 WN354 displays its extended radar 'dustbin' during an exercise with Royal Navy ships. Delivered in April 1954, WN354 was struck off in November 1961.

The first FAA unit to receive Gannet AS.1s was 703X Squadron at RNAS Ford, Sussex, which formed on 15 March 1954 to undertake intensive flying trials of the aircraft. Its aircraft and personnel were dispersed to other units when the trials concluded in December 1954.

Gannet AS.1s served with seven frontline squadrons. The first to re-equip was 826 Squadron, shore-based at RNAS Lee-on-Solent, Hampshire, which replaced its Fairey Fireflies on 17 January 1955. During the next two months Gannets arrived at HMS Gannet, RNAS Eglinton in County Londonderry, for 824 and 820 Squadrons, both units deploying them on HMS Bulwark during the year, although 824 Squadron transferred to HMS Ark Royal in October. Other front-line squadrons with AS.1s were 812, 815, 825 and 847. While most were carrier deployed ASW units, 847 Squadron was different. It was a shore-based unit established to monitor shipping around Cyprus as part of efforts to interdict arms heading for EOKA guerrillas active on the island.



With its contra-rotating propellers and multitude of fins, the Gannet could hardly be mistaken for anything else. These AS.1s of No. 825NAS were based at RNAS Culdrose, Cornwall in 1957.

Gannets were also issued to 1840/1842 Squadron of the Royal Naval Volunteer Reserve (RNVR) at RNAS Ford in early 1956. While plans to create additional RNVR anti-submarine units were made, the Air Branch was disbanded as part of the March 1957 defence cuts.

A single Gannet AS.1 (WN365) was modified as the prototype T.2 conversion trainer, with production aircraft initially entering service with the Naval Anti-Submarine School (737 Squadron) at RNAS Eglinton from March 1955. A total of 38 Gannet T.2s were built including some for the Royal Australian Navy (RAN), all at Hayes. A further eight trainers powered by the more powerful (by 85ehp!) Double Mamba 101 were produced for the FAA as Gannet T.5s.

The second anti-submarine variant for the FAA was the AS.4, effectively the AS.1 airframe powered by the same engine as the T.5. Armstrong Siddeley first installed a Mk 101 engine in AS.1 WN372 for flight testing, the aircraft reflying after modification on 12 March 1956 from Northolt. The first production AS.4 (XA412) made its maiden flight on 13 April 1956 and a total of 74 are understood to have been produced (including examples for export), while some AS.1s were also upgraded.

The variant entered service with 824 Squadron in October 1956 and also replaced Mk 1s with 814, 825 and 815 Squadrons the following year. Two other units, 847 and 810 Squadrons, also flew Gannet AS.4s; the former replaced its AS.1s to continue its surface patrols from Cyprus, while the latter received them in April 1959 as a stopgap while problems with the aircraft's replacement – the Westland Whirlwind HAS.7 helicopter – were fixed.

The last FAA anti-submarine unit with Gannets was 810 Squadron at RNAS Culdrose, which disbanded on 12 July 1960. While most

Bundesmarine personnel examine a torpedo alongside Gannet AS.4 UA+102, ex-XG 834. The main British air-launched torpedo of the day was the 18in Dealer-B.

Gannet AS.1/4s entered storage with the Aircraft Holding Unit at Abbotsinch – and were eventually scrapped – some served on in other roles. Six surplus AS.4s were stripped of ASW equipment for carrier onboard delivery (COD) in 1960/61, while others became AS.6s (also known as ECM.6s) for 831 Squadron, the FAA's electronic warfare training unit.

Gannets also served with the naval air arms of three overseas customers. The only other nation to operate them from an aircraft carrier was Australia. On 28 October 1955 HMS Majestic was commissioned as HMAS Melbourne by the RAN. Its air wing would include Gannets, with 37 AS.1s and three T.2s ordered in 1952, although three Mk 1s were later cancelled.

Nos 816 and 817 Squadrons formed at RNAS Culdrose on 18 August 1955 to fly the Gannets, both travelling on HMAS Melbourne to RANAS Nowra, New South Wales, where they arrived in May 1956. Both operated from Melbourne for four cruises around the Far East before 817 Squadron disbanded on 18 August 1958. This left 816 Squadron, which was destined to become the unit to operate the anti-submarine Gannet at sea the most times, over the longest period. Between October 1958 and August 1967 it participated in 12 further deployments on HMAS Melbourne. It disbanded at RANAS Nowra on 25 August 1967, ending the career of the Gannet ASW variants at sea. Australian Gannets also served with 724 and 725 Squadrons in training roles, with the former retiring its last examples in November 1966.

West Germany became the second export customer, ordering 15 Gannet AS.4s and a single T.5 in 1956 for its embryonic naval air arm. To hasten deliveries aircraft were diverted from existing Royal Navy contracts, while German crews received their initial training with Fairey at White Waltham before moving to RNAS Eglinton, where the Gannet T.5 was delivered via Blackbushe, Hampshire, on 6 March 1958. The first squadron of Marinefliegergeschwader 1 (MFG 1) formed at Eglinton that May with its initial Gannet AS.4s, supplemented by others loaned to it by the FAA, before flying to Schleswig-Jagel in late July. German Gannets were tasked with anti-submarine and anti-shipping roles over the Baltic.

MFG 1/1 moved to Westerland/Sylt in 1962, but it passed the Gannets to MFG 3 at Nordholz in November 1964, by when the West German Navy was looking for a replacement with greater endurance and more modern avionics. This resulted in the purchase of the Breguet Atlantic, arrival of which allowed the Gannets to be phased out of service from June 1966.

Indonesia ordered 16 Gannet AS.4s and a pair of T.5s for its naval air arm in 1957, which Fairey fulfilled by acquiring 20 AS.1 and two T.2 airframes from the FAA to refurbish and upgrade. Crew training took place at White Waltham and the first two aircraft arrived in Indonesia in 1960. They were based at Morokrembangan in Surabaya, with SkwU100. The final pair left the UK on 18 January 1962.

From 1964 into 1966 Indonesian Gannets flew coastal patrols and reconnaissance sorties during the Confrontation with Malaysia. By then, the UK had stopped spares shipments for the fleet. Only a handful remained active by 1971, but a lack of spares meant they were withdrawn soon afterwards.

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Indonesia was a little-known Gannet user, but received 18 aircraft, using them operationally in the 1960s. This AS.4 was one of two known to wear the Indonesian Navy serial AS-15.

Fairey Gannet AS.Mk 4

Crew:	Three; pilot, observer and operator
Length:	43ft 0in (13.11m)
Wingspan:	54ft 4in (16.56m)
Height:	13ft 9in (41.18m)
Empty weight:	15,069lb (6,835kg)
Max T/O weight:	23,446lb (10,635kg)
Powerplant:	One Armstrong Siddeley Double Mamba Mk 101 twin turboprop rated at 3,035ehp (2,264ekW)
Max speed:	290mph (481km/h)
Range:	662 miles (1,065km)
Service ceiling:	25,000ft (7,620m)
Armament:	Two torpedoes, or mines, depth charges or bombs carried internally, and up to 16 3in rocket projectiles under the wings

Grumman S-2 Tracker

The Stoof

Designed in the early 1950s for ASW missions from carriers, the S-2 Tracker served the US Navy for many years, and numerous foreign operators from land and sea into the 21st Century.

The Tracker was purpose-built for the carrier ASW mission, being small enough to fit on escort carriers, yet roomy enough to house sensors and operators and carry weapons, combining the hunter and killer roles in one package.

The first of two prototypes, XS2F-1 129138, flew at Bethpage, New York on 4 December 1952.

Production amounted to 755 S2F-1s, (S-2As) and S2F-1As (S-2Bs) and 60 S2F2s (S-2Cs), which differed in having an enlarged bomb bay to accommodate homing torpedoes and nuclear depth charges. The S2F-3 (S-2D) had an 18in (0.45m) fuselage extension, a 35in (0.89m) greater wingspan, a wider cockpit and improved equipment. The S2F-3S (S-2E) had improved avionics.

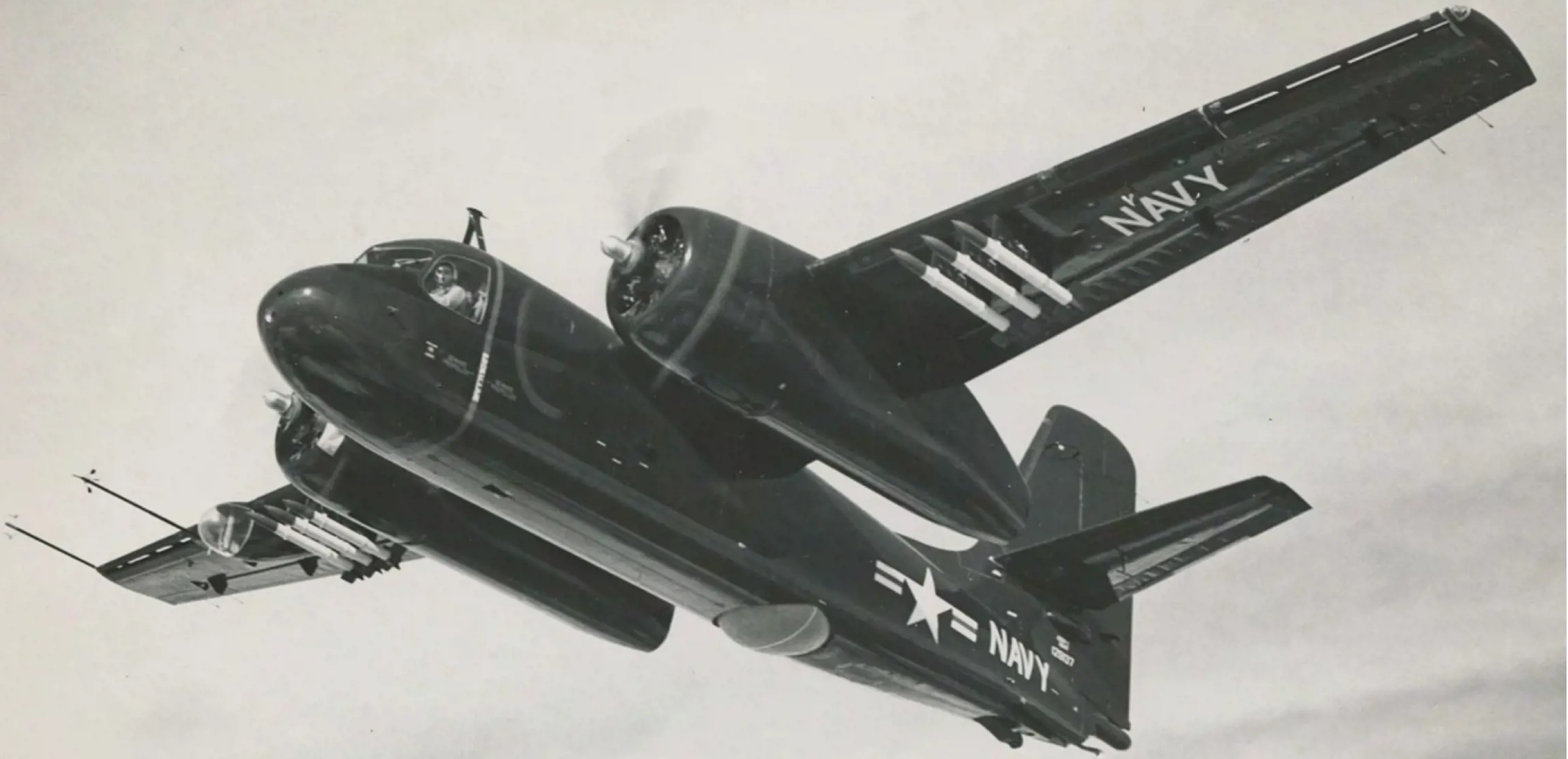
The S2F-1S1 (thankfully) became the S-2F after 1962. It had Julie/Jezebel sonar homing gear.

Prominent above the cockpit of many Trackers was an AN/APA-69 electronic direction-finding (EDF) antenna in a teardrop fairing. An AN/APS-38 search radar was mounted in a retractable ventral 'dustbin' radome, behind the weapons bay. A 70m candlepower searchlight was mounted on the starboard wing, and a AN/ASQ-10 MAD boom could be extended from the tail.

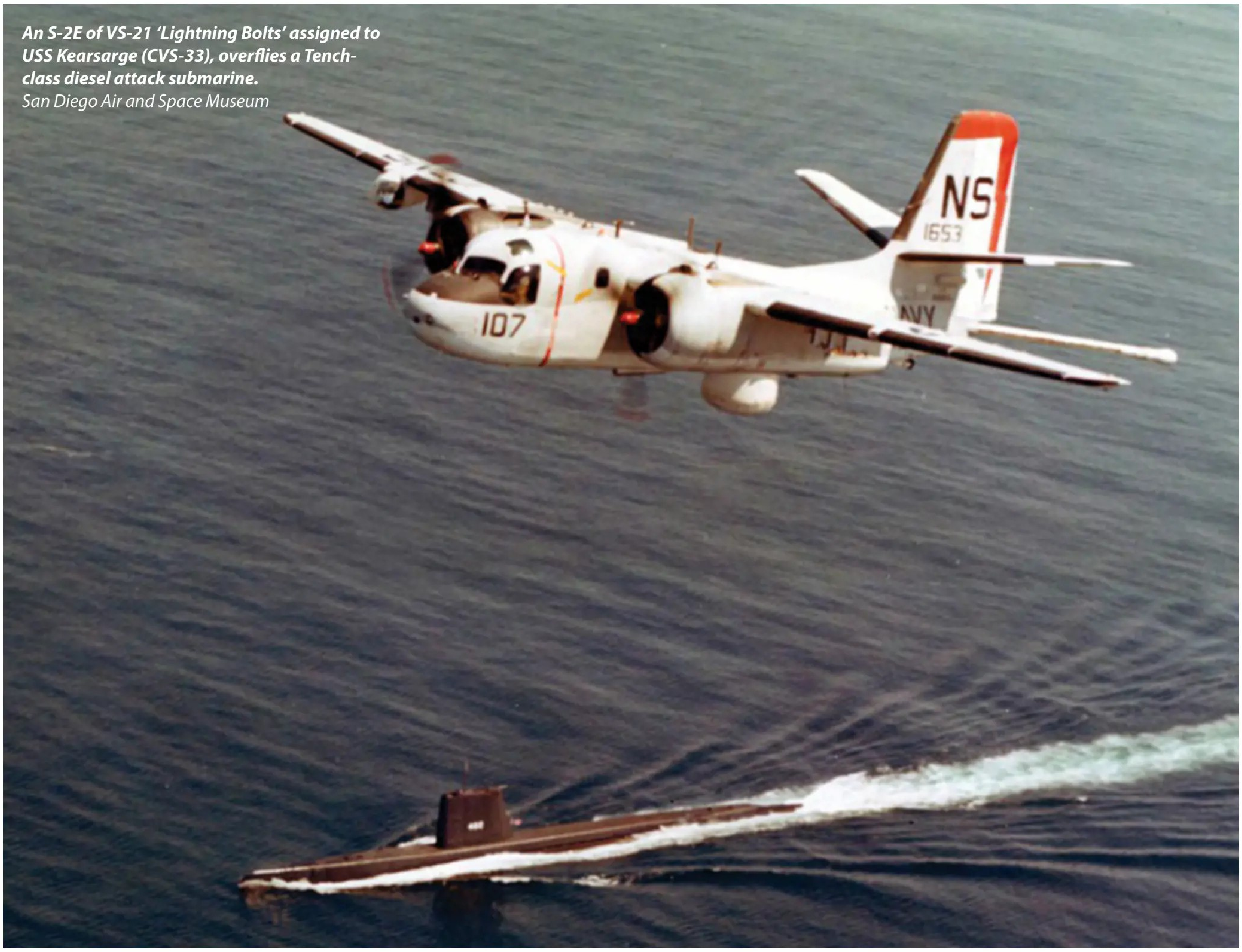
The S2F-1 entered service in February 1954 with VS-26 'Lucky Tigers' at Norfolk, Virginia and served with 22 operational ASW squadrons. They operated at sea initially aboard small escort carriers, then as part of the air wings on attack carriers (CVA), then on dedicated ASW carriers (CVS) converted from *Essex*-class ships as newer supercarriers entered the fleet.

USN Trackers were vital in monitoring Soviet surface and submarine traffic during the Cuban Missile Crisis of 1962.

In Vietnam, where there was no submarine threat from the North, Trackers kept an eye



The first Tracker prototype, X2SF-1, Bu.No. 129137, armed with rockets. Note the retracted ventral radar unit.



An S-2E of VS-21 'Lightning Bolts' assigned to USS Kearsarge (CVS-33), overflies a Tench-class diesel attack submarine.
San Diego Air and Space Museum

on Soviet subs, assisted SAR efforts and occasionally used rockets against infiltrating surface vessels and NVA patrol boats. An S-2E was apparently shot down in January 1966 on such a mission.

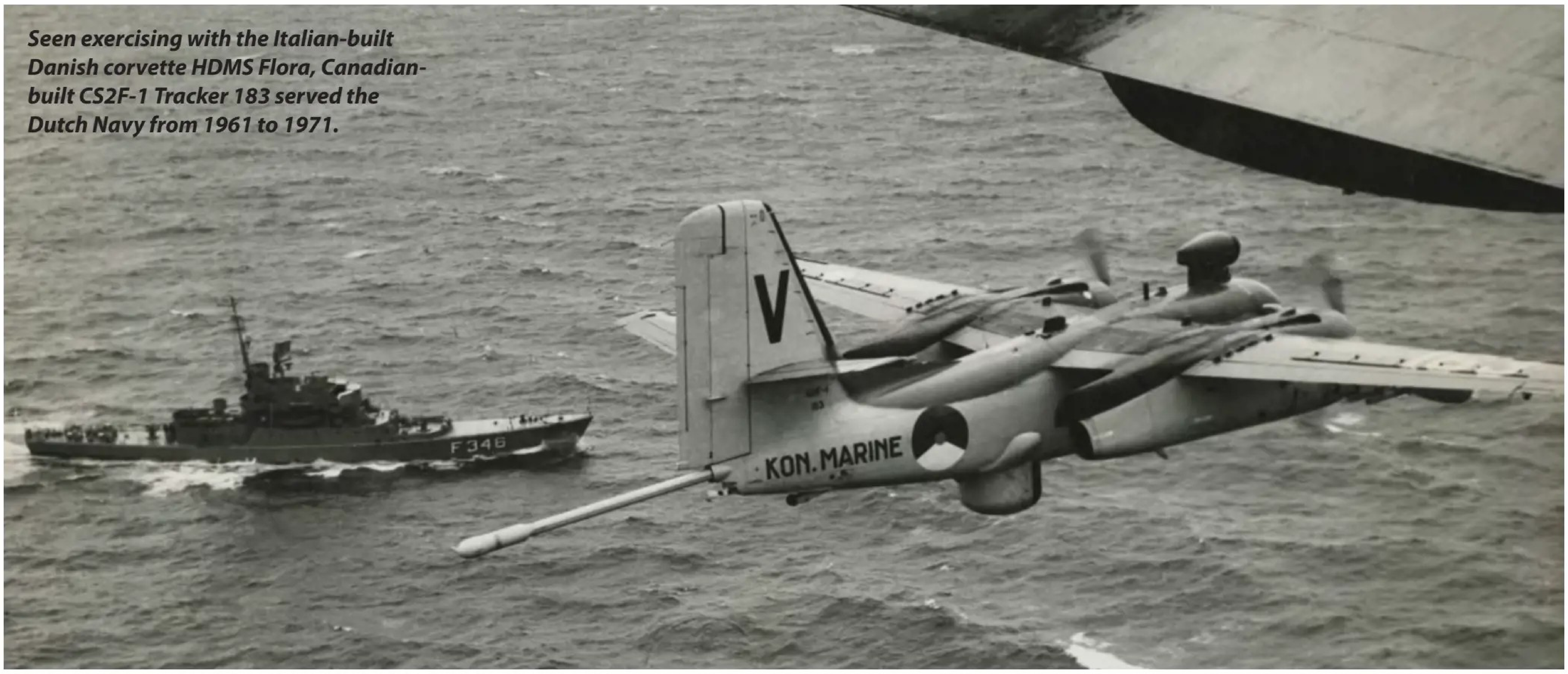
No fewer than 29 Naval Reserve squadrons were issued Trackers, and almost every Naval Air Station or Facility worldwide had some for training or utility duties, using TS-2 and US-2 versions, respectively, the last being retired in 1986, a decade after VS-37 handed in the final US operational Trackers.

More than 340 Trackers were exported to 14 foreign nations, one of which produced the type under license. De Havilland Canada built 99 CS2Fs at Downsview, Ontario, the first flying in May 1956. These were equipped with Canadian equipment, including radar. The first operational squadron, VS 881, formed in February 1957 and embarked on HMCS *Bonaventure* in September. The carrier was retired in 1969, but Trackers continued on land-based patrol duties until 1980 . The majority (57) of RCN Trackers were CS2F-2s, fitted with improved MAD and radar. Of the C2SF-1s, 17 were delivered to the Royal Netherlands Navy (MLD). Two were converted to utility/carrier onboard delivery (COD) configuration with ASW gear replaced by seats for six personnel.

Under a 1959 agreement, the USA supplied the MLD with 43 new Trackers under MDAP, including the 17 CS2F-1s (CS-2As). Some replaced Avengers at Hato in the Dutch Antilles, while most equipped VSQ-2 at Valkenburg and occasionally aboard the carrier *Karel Doorman* until it was retired in 1968. A modernisation programme turned 18 into S-2Ns in the early 1970s, but the type was retired from Dutch service in December 1975. Eight S-2s went to Turkey and eight returned to the USN. One Tracker was hijacked by a disgruntled mechanic who was refused a transfer to pilot school. He flew from Malta to Libya and was granted political asylum, but eventually returned to the Netherlands.

Grumman S-2E Tracker

Crew:	Four; pilot, co-pilot/ navigator and two systems operators
Length:	43ft 6in (13.26m)
Wingspan:	72ft 7in (22.12m)
Height:	16ft 7in (5.05m)
Empty weight:	19,033lb (8,633kg)
Max T/O weight:	29,150lb (13,222kg)
Powerplants:	Two Wright R-1820-82WA Cyclone piston engines, each rated at 1,525hp (1,138kW)
Max speed:	242mph (389km)
Service ceiling:	18,000ft (5,486m)
Range:	1,000 miles (2,609km)
Armament:	Torpedoes conventional and nuclear depth charges, up to 16 5in rockets on underwing racks, AGM-12 Bullpup missiles



Seen exercising with the Italian-built Danish corvette HDMS Flora, Canadian-built CS2F-1 Tracker 183 served the Dutch Navy from 1961 to 1971.

Australia purchased 16 S-2Es in 1965, flying them from the carrier HMAS *Melbourne* A hangar fire at Nowra destroyed nine of them in 1976. An existing order for six S-2Gs was increased to 16. After *Melbourne* was decommissioned in 1982, the Trackers were retired two years later.

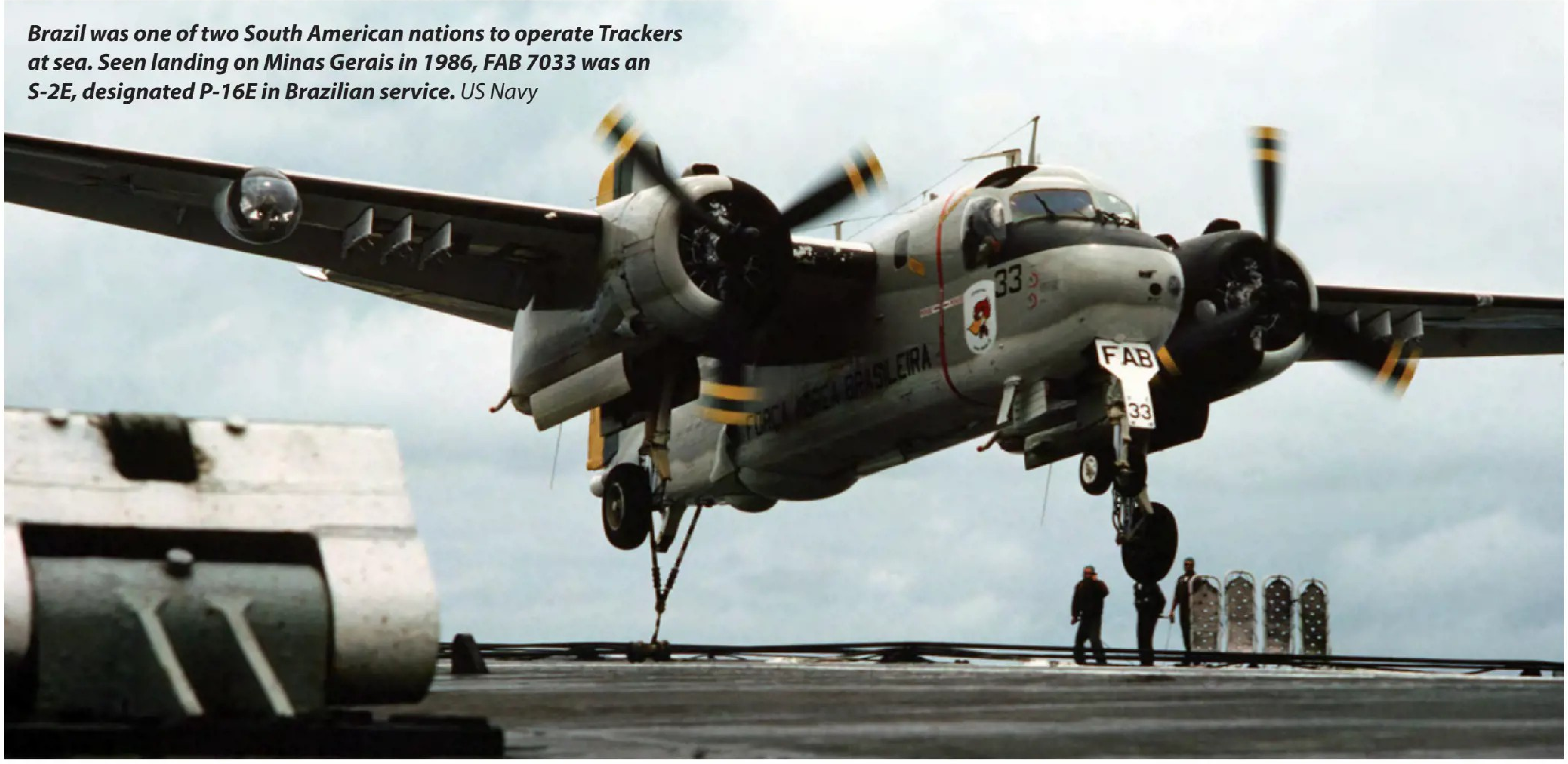
Italy's first S2F-1s arrived in 1957, with further batches in 1959, 1961 and 1964 for a total of 45. The last group included ten with non-folding wings, which gave extra range. They were maintained by the *Aeronautica Militare* (Air Force), although controlled by the *Marinavia* (Naval Aviation) with crews from both services. The arrival of the Atlantic saw the Tracker phased out by 1978.

Japan was the largest non-US operator, with 60 S2F-1s arriving in 1957-59. Some were stored in the mid-1970s with the object of reactivating them later, but this did not occur and the fleet was phased out by 1984. South Korea bought 30 use S-2As and S-2Es in 1976, with the air force operating some in the electronic warfare role. They were mothballed by 1995.

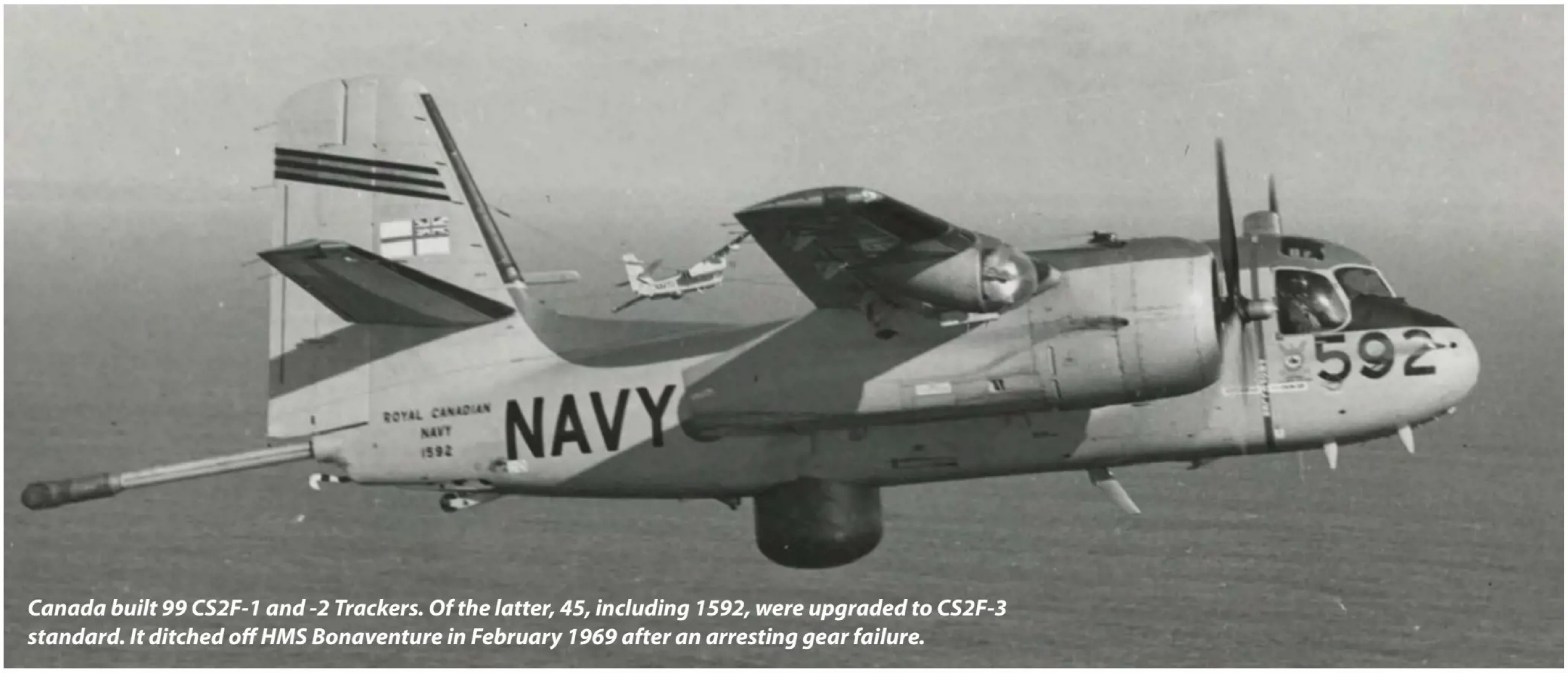
The Republic of China (Taiwan) transferred its remaining S-2Ts from the ROC Air Force to the Navy in 1998, having received 25 Trackers, mostly S-2Es, in 1978-79. They were replaced by P-3 Orions in the 2010s.

From 1966-67, Thailand equipped land-based No. 101 Squadron of the Royal Thai Navy Air Division with 14 Trackers, a mix of S-2As, US-2Bs, US-2C and S-2Fs. By the mid-1980s they were obsolescent and relieved of their ASW duties, but continued flying surveillance and training missions. Several are in storage at U-Tapao.

Turkey (now Türkiye) received eight ex-MLu S-2As for training in 1971, followed by 12 S-2Es from the US Navy in 1972 and seven more in 1978-80, and a further 12 by 1987. These were used to monitor Soviet naval movements in the Black Sea, but by the early 1990s they were becoming unreliable, suffering engine failures and several crashes, and in 1993 the remaining fleet was grounded. They remained in storage



Brazil was one of two South American nations to operate Trackers at sea. Seen landing on Minas Gerais in 1986, FAB 7033 was an S-2E, designated P-16E in Brazilian service. US Navy



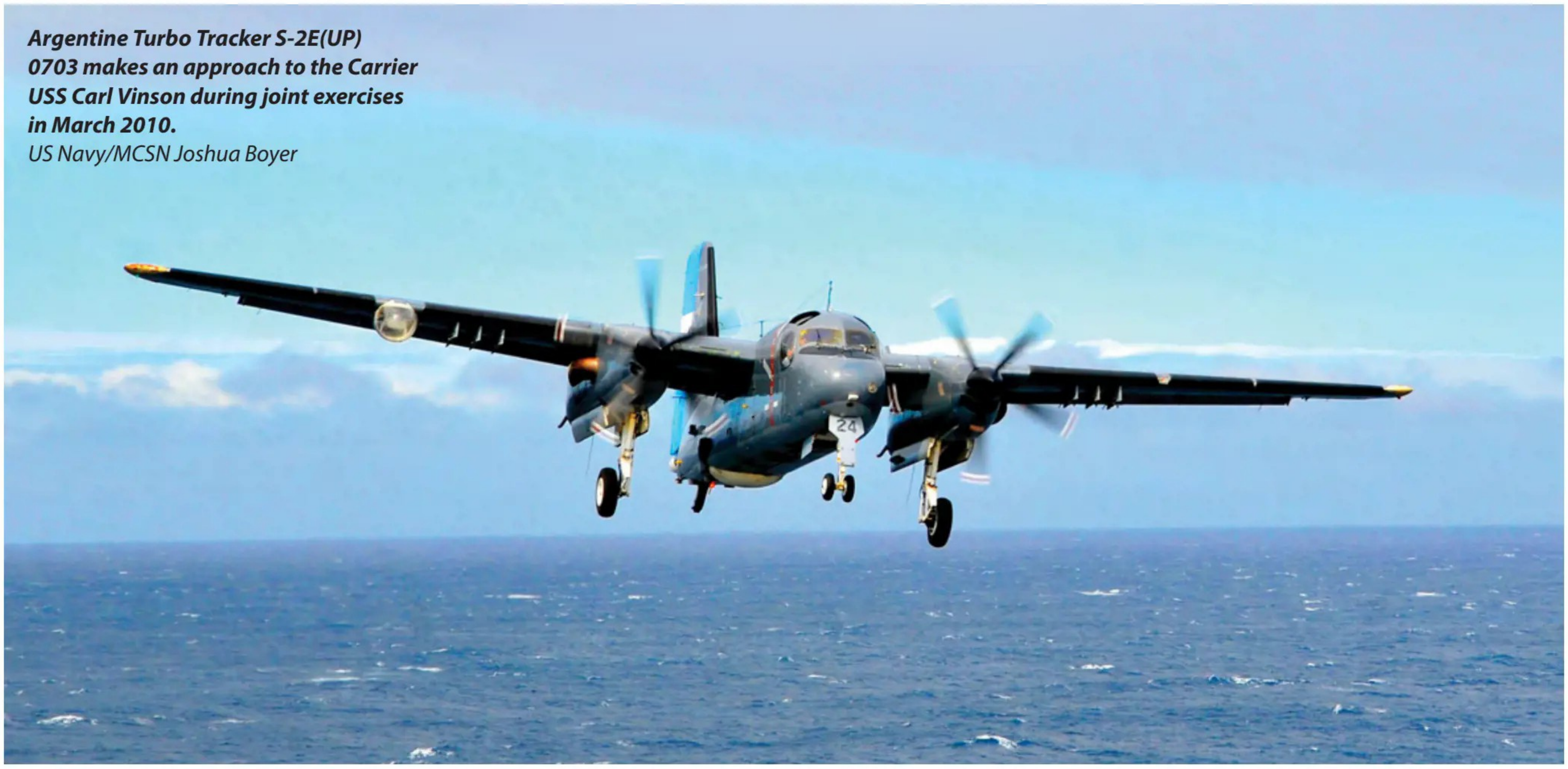
Canada built 99 CS2F-1 and -2 Trackers. Of the latter, 45, including 1592, were upgraded to CS2F-3 standard. It ditched off HMS Bonaventure in February 1969 after an arresting gear failure.

pending a turbine conversion programme, but it seems only one was completed for the Turkish forestry ministry.

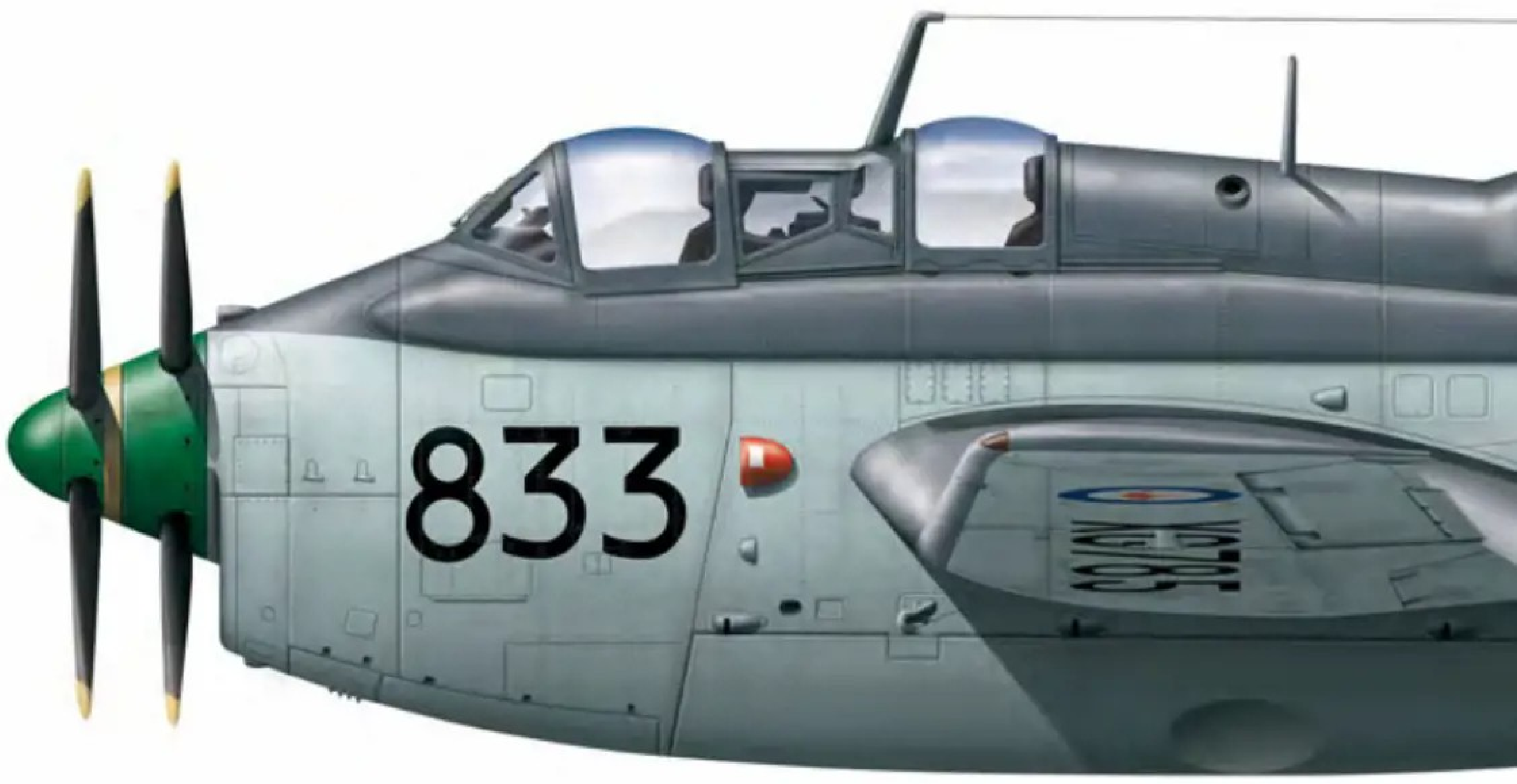
The Tracker was used by several Latin American nations. Deliveries to Argentina comprised six S-2As in 1962, one S-2F in 1967 and six S-2Es in 1978. They operated from the carriers ARA *Independencia* and later, *25 de Mayo*. Three of the S-2As were stripped of ASW gear and used as transports, but four S-2Fs were embarked for operations in the 1982 Falklands War and provided valuable service, locating British Task Force ships for attack by strike aircraft. After the war they were progressively upgraded, and eventually six became S-2E(UP)s with Garrett TPE-331 turboprops, rated at 1,250shp (930kW), driving five-bladed Hartzell propellers. This gave the Argentine Navy Trackers a new lease of life, and even though the *25 de Mayo* was decommissioned in 1997, they continued to deploy occasionally at sea on Brazil's *Minas Gerais* and *São Paulo* until formally retired in mid-2021. In 2024 slow deliveries of the P-3 Orion led Argentina to seriously consider putting some S-2Ts back in service.

Brazil's Trackers were owned by the Air Force (*Força Aérea Brasileira*) but operated by the Navy (*Naval Brasiliera*) when aboard *Minas Gerais*. The 13 S2F-1s delivered in 1961-2 were followed by eight S-2Es in 1976. One was tested with PT6A turboprops, but these were not adopted and the last Trackers were retired with the carrier in 1996.

Peru's naval air arm acquired ten S-2Es in 1976 and three S-2Gs as attrition replacements in 1983. They were withdrawn by 1989. Under MDAP, Uruguay was supplied with three S-2As in 1964 and bought three reconditioned S-2Gs in 1983. The last was used for coastal patrol until 1999. Venezuela was the recipient of six S-2Es in 1974 and two more in 1981. Replaced in the ASW role by helicopters, the last of the *Armarda Venezolana*'s Trackers were retired in the early 1990s.



Argentine Turbo Tracker S-2E(UP) 0703 makes an approach to the Carrier USS Carl Vinson during joint exercises in March 2010.
US Navy/MCSN Joshua Boyer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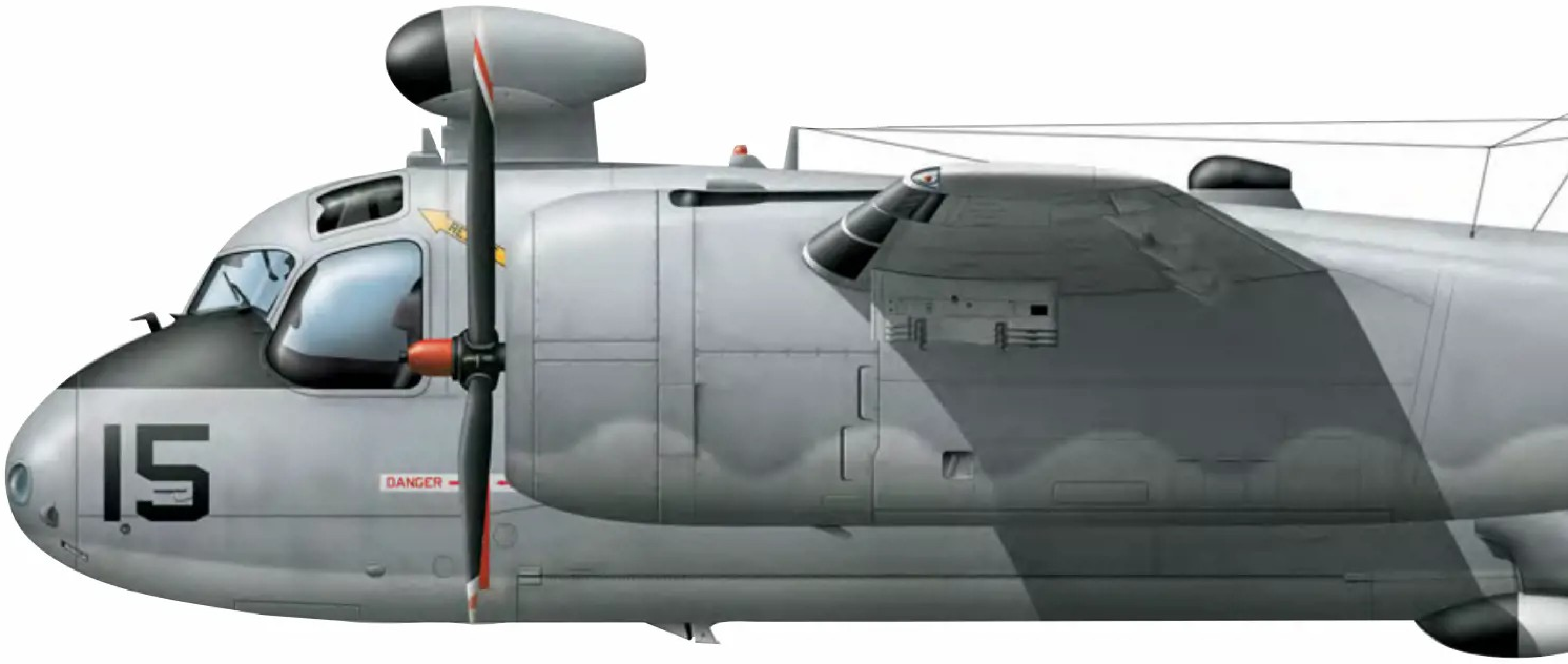
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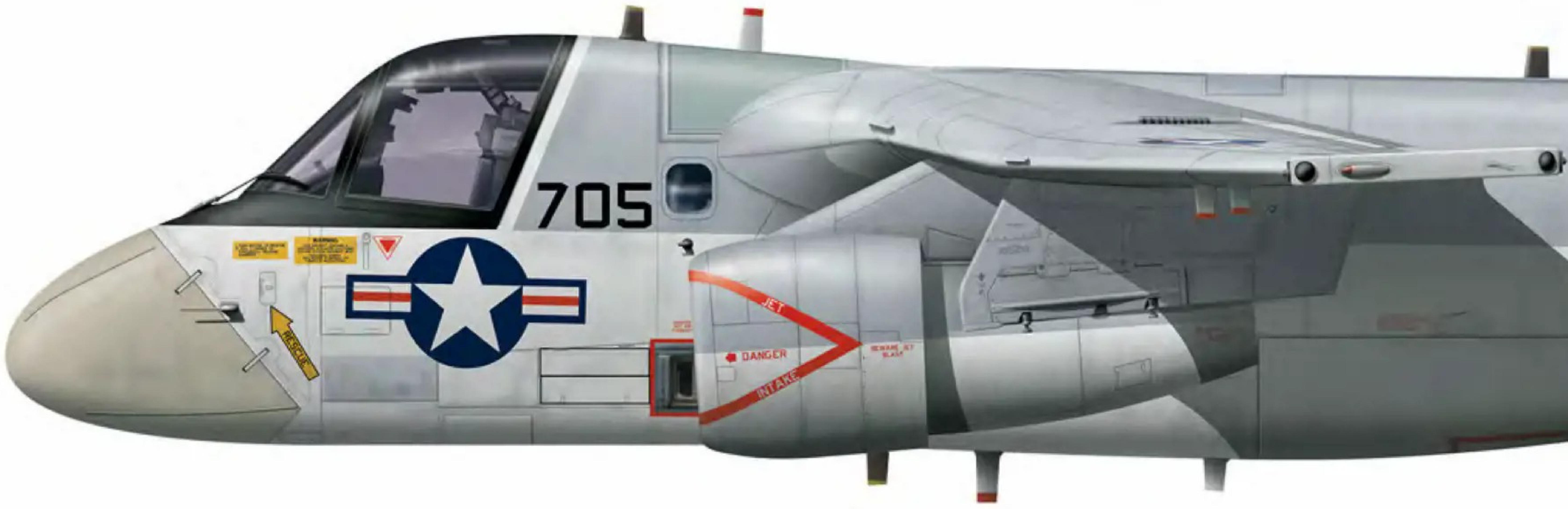
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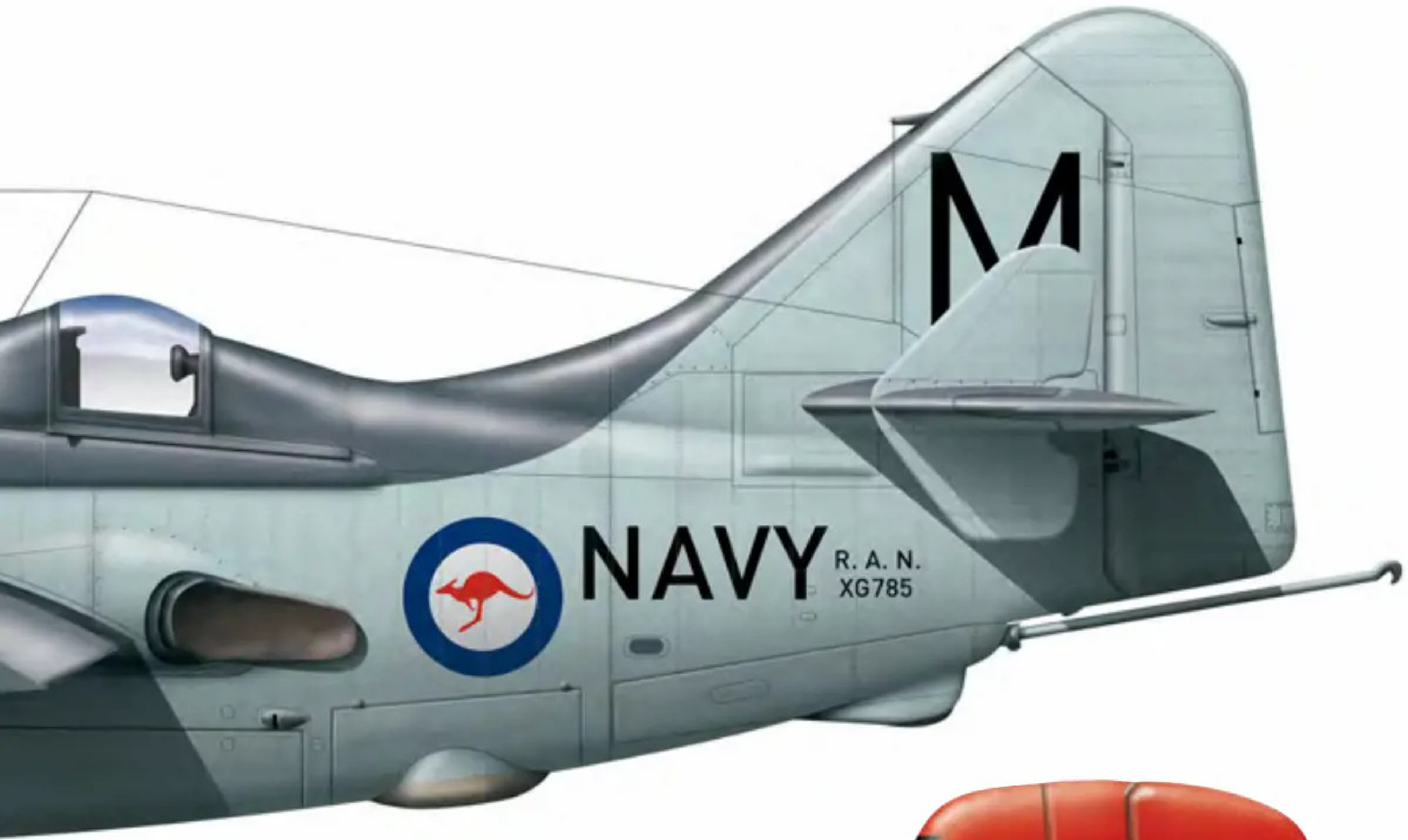
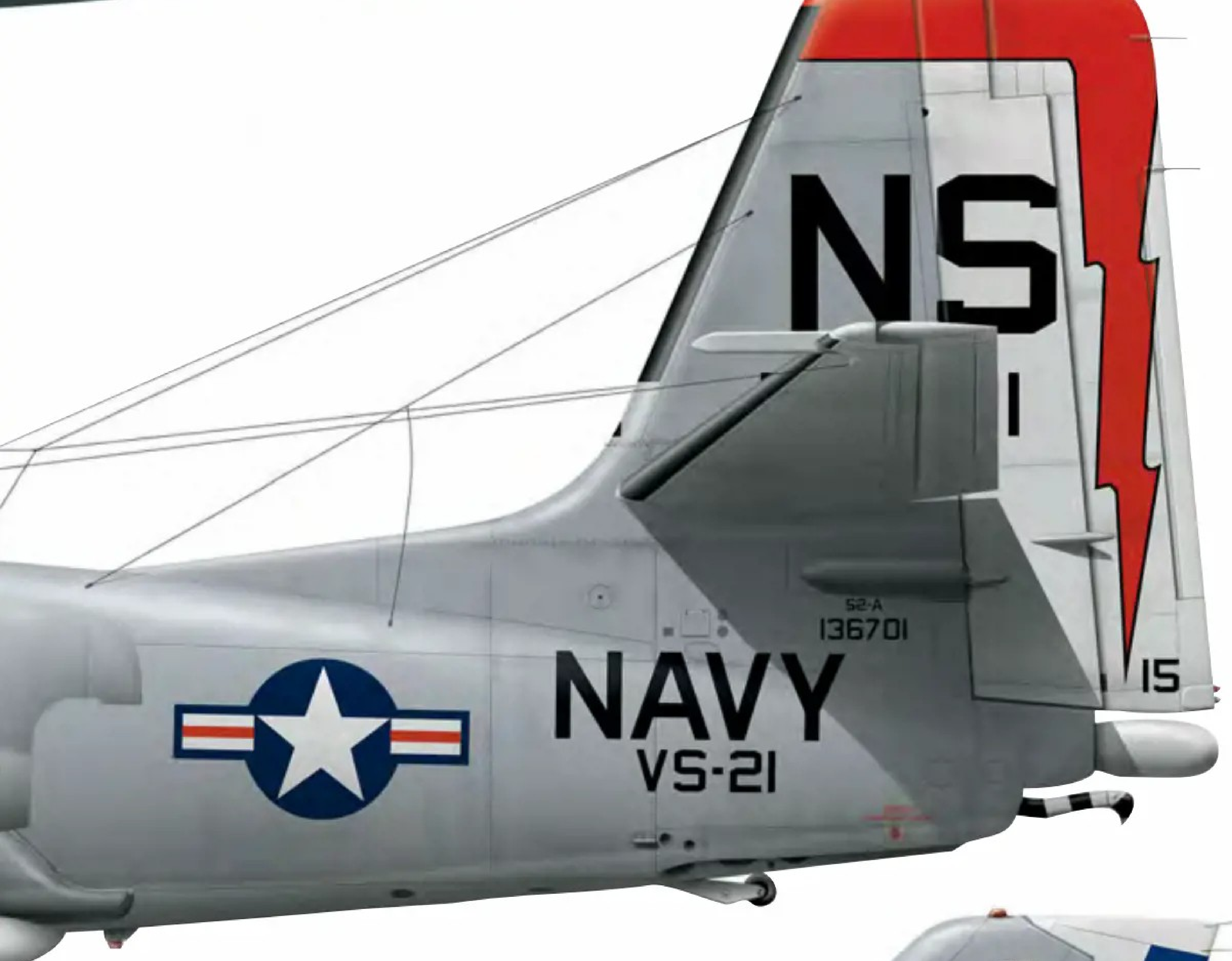


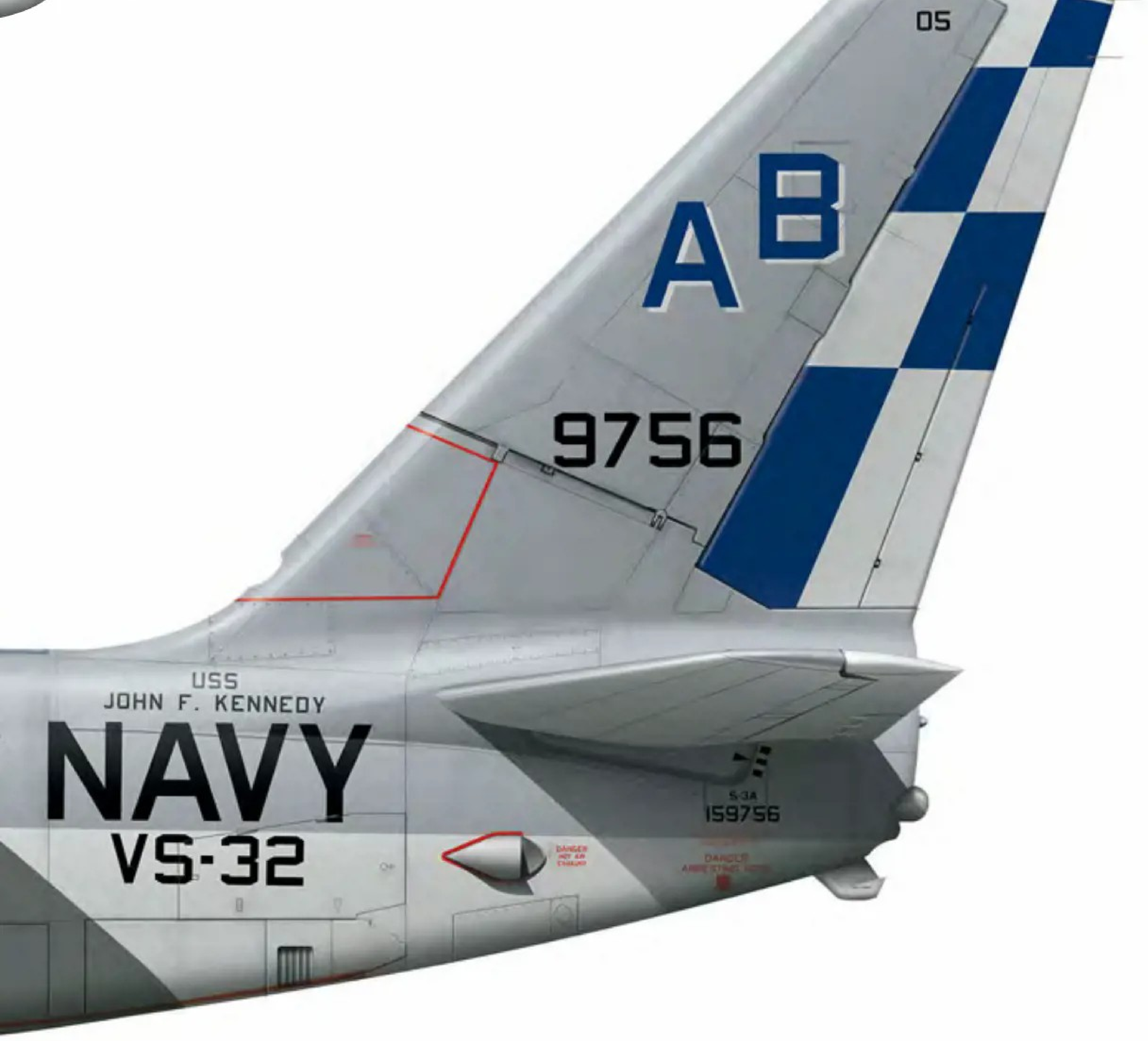
Fairey Gannet AS.1 XG785, C/N F9353
816 NAS, HMAS Melbourne,
Royal Australian Navy, 1960

Gannet AS.1 XG785 made its first flight on July 15, 1957. It was delivered to the RAN in the UK 28 November that year and arrived in Australia in September 1958 as part of an attrition batch. Shore-based at Nowra, New South Wales or embarked aboard HMAS Melbourne, it wore the codes 833/M, 813/M and 813/NW at different times. The green and yellow on the spinner marks it as a No. 816 NAS aircraft. It was sold for scrap in March 1967 and subsequently broken up.



Grumman S-2A Tracker
Bu. No. 136701, C/N G-610
VS-21, CVSG-53
USS Kearsage (CVS-33)
United States Navy 1963

This is a late production S-2A fitted with AN/APA-69A ECM set in the radome above the cockpit and a 70m candlepower AN/AVQ-2A searchlight under the starboard wing. It was delivered to anti-submarine squadron VS-37 'Sawbucks'in 1959. In 1963 it was with VS-21 'Fighting Redtails' as served for at least two years with the unit, which made cruises to the eastern Pacific and to Vietnam waters in this period aboard USS Kearsage. Upgraded to S-2F standard, by 1966 it was assigned to Replacement Air Wing RAW-93 at NAS Willow Grove, Pennsylvania. In July that year it was sent for storage to AMARC at Davis-Monthan AFB, Arizona.

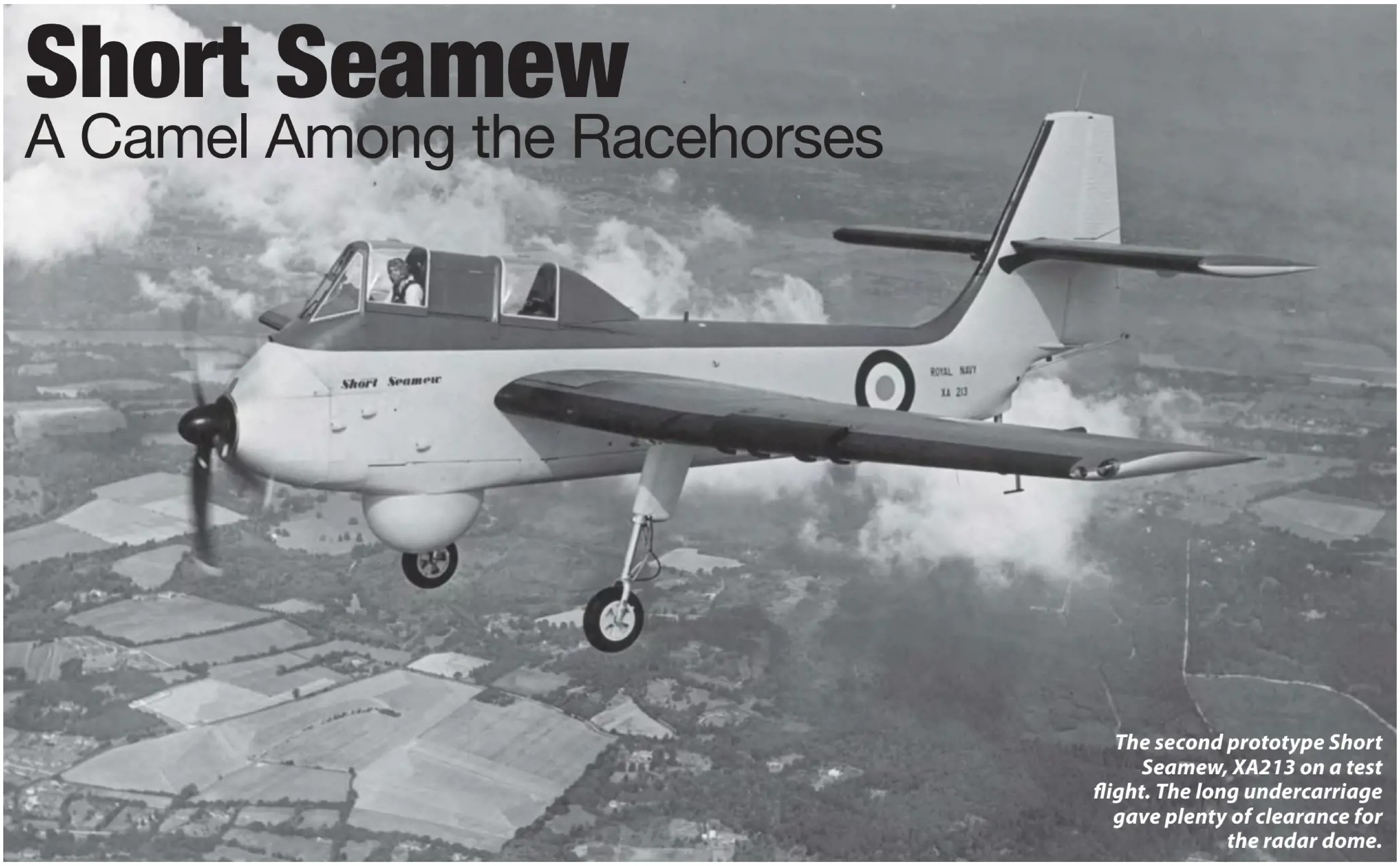


Lockheed S-3A Viking
Bu. No. 159756, C/N 394A-3085
VS-32, CVW-1
USS John F. Kennedy (CV-67), 1977

Viking 159756 was was one of the original 10 S-3As received by VS-32 when it transitioned from the S-2 in 1976. As part of a Mediterranean cruise with VS-32 'Maulers', it appeared in the flying display at the 1977 Air Tattoo at RAF Greenham Common. Later converted to an S-3B, it was exhibited at the 2002 Farnborough Air Show with VS-33 'Screwbirds', which was then embarked aboard USS Theodore Roosevelt (CVN-71) and is believed to have also served with VS-27, VS-35 and VS-41. It was retired to the 309th Aerospace Maintenance and Regeneration Center (AMARC) at Davis-Monthan AFB in August 2006

Short Seamew

A Camel Among the Racehorses



The second prototype Short Seamew, XA213 on a test flight. The long undercarriage gave plenty of clearance for the radar dome.

The Short Seamew was designed as a simple, cheap and lightweight anti-submarine aircraft in response to the growth in the size of the Soviet Navy's submarine fleet.

It was designed for the Fleet Air Arm (FAA) in response to Specification M.123D, which called for an anti-submarine platform to operate from smaller aircraft carriers. Three prototypes of the Short SB.6 (PD.4) were ordered in April 1952, with Walter J 'Wally' Runciman at the controls of the first (XA206) for its maiden flight from Sydenham, Belfast, on 23 August 1953. The aircraft was damaged landing (but quickly repaired), while its handling in the air was described as 'vicious', with overbalanced and badly harmonised controls. The Seamew also flew nose down with the flaps lowered, while airflow around the fin/tailplane join was disrupted. These problems were tackled by making changes to the airframe – including the addition of slats and slots – but the Seamew was still considered difficult to handle.

The second prototype (XA213) flew in early 1954 and, unlike the first, was fully representative of the production version, including a radome for an ASV Mk 19B search radar under the front fuselage. From 12 July 1955, and again that December, the aircraft conducted sea trials from HMS *Bulwark*, its slow approach speed making carrier operations relatively easy. The third airframe (XA216) was used as a non-flying structural test rig.

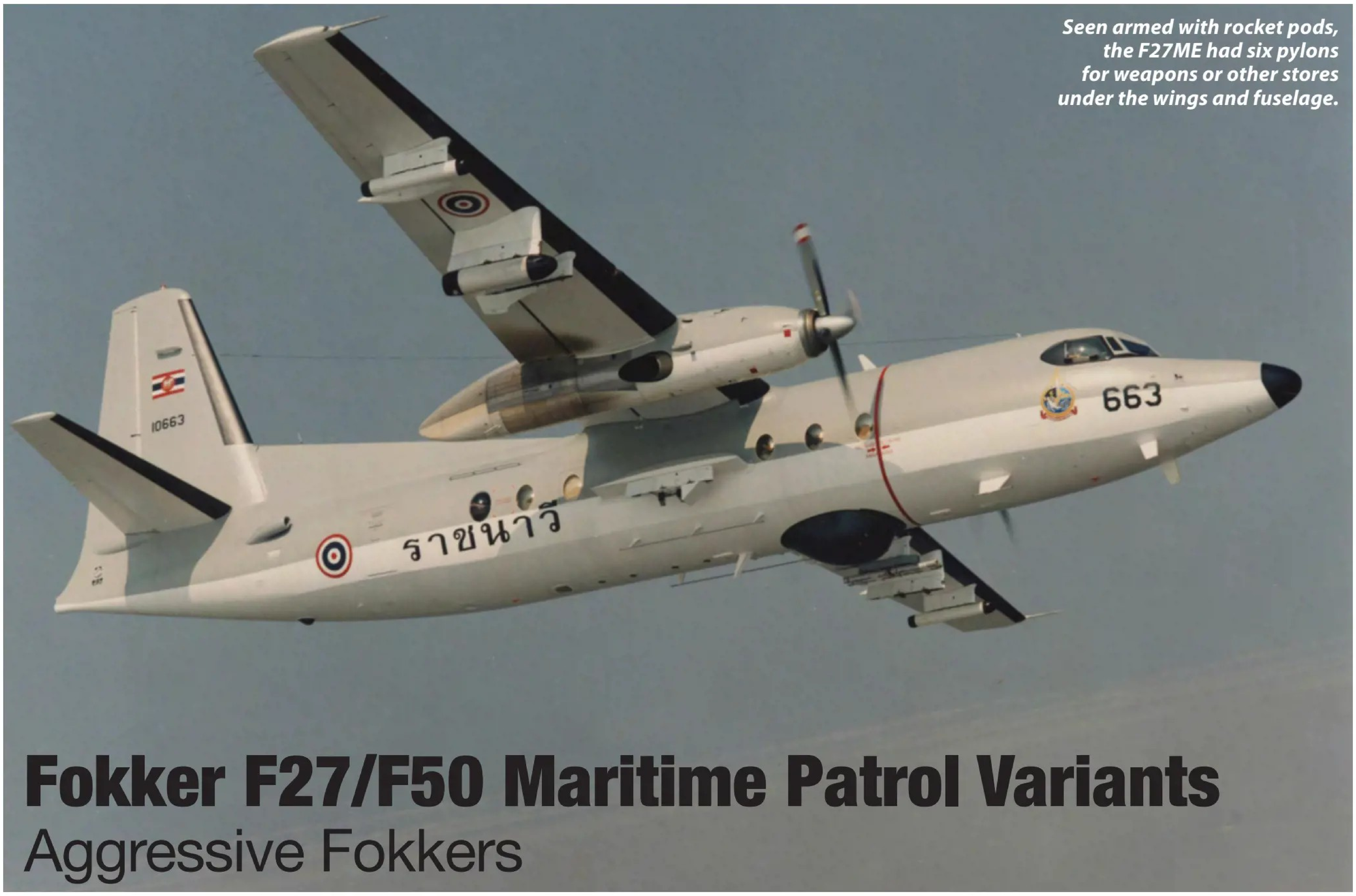
In February 1955 an order was placed for 30 Seamew AS.1s for the FAA, plus 30 Seamew MR.2s for RAF Coastal Command. The RAF wanted to use the Seamew for short range maritime patrols, freeing up its Avro Shackletons for longer range operations. The two variants were nearly identical, except the MR.2 had larger wheels with low-pressure tyres, manual (rather than hydraulic) wing folding and lacked an arrestor hook or other carrier gear.

The first production AS.1 (XE169) flew on 3 March 1955. Seamews were delivered to Lossiemouth from 1956, with some going to No. 700 Squadron for intensive service trials that November. By then, after a handful of MR.2s had been produced and others partially completed, the RAF had lost interest, while the FAA wanted just 24 AS.1s to equip squadrons of the Royal Naval Volunteer Reserve (RNVR). Shorts tried to find export customers to extend the production run, with Runciman demonstrating the aircraft in Italy, Yugoslavia and West Germany between March and May 1956, without success. (He was killed on 9 June displaying the aircraft after arriving back at Belfast.)

By the end of 1956 two Seamews operating from Lossiemouth had completed 200 deck landings and take-offs from HMS *Warrior* and it appeared that the aircraft was close to service entry. These hopes were dashed in March 1957, however; the Defence White Paper released that month not only disbanded the Air Branch of the RNVR Reserve but also cancelled the Seamew. Only 24 aircraft had been completed, many of which were still awaiting delivery.

Short SB.6 Seamew AS.1

Crew:	Two (pilot and navigator)
Length:	41ft 0in (12.50m)
Wingspan:	55ft 0in (16.76m)
Height:	13ft 5in (4.09m)
Empty weight:	9,795lb (4,443kg)
Max T-O weight:	15,000lb (6,804kg) overload weight
Powerplant:	One Armstrong Mamba ASM.6 turboprop, rated at 1,590shp (1,190kW)
Max speed:	250mph (402kmh)
Service ceiling:	19,000ft (5,791m)
Range:	750 miles (1,210km)
Armament:	Up to 1,844lb (836kg), typically four depth charges in bomb bay, plus six rocket projectiles under wings



Seen armed with rocket pods, the F27ME had six pylons for weapons or other stores under the wings and fuselage.

Fokker F27/F50 Maritime Patrol Variants

Aggressive Fokkers

The successful Friendship family of turboprop airliners has formed the basis for a number of armed and unarmed maritime variants

First flown on 24 November 1955, the Rolls-Royce Dart-powered Fokker F27 was adopted in 1960 by the Dutch Air Force as the F27-300M Troopship, and military transport variants, mostly based on the higher-performance -400M, were operated by more than 20 countries, from Algeria to the USA. A dedicated patrol version was launched in 1975 as the F27 Maritime, fitted with Litton APS-504 search radar in a belly blister and a tactical compartment for up to six crew.

Unsurprisingly, the Netherlands was an early customer. Its two F27MARs were delivered in 1981-82 to 336 Squadron of the KLu, although they were flown by Navy crews. serving at Hato Airport, in Curaçao in the Netherlands Antilles on anti-smuggling and fisheries protection patrols, and SAR duties. In 1996 their control was passed to the Coast Guard, but in 1999 they were retired. Spain used three F27s for similar purposes from the Canary Islands with *Esquadron* 802.

The Philippine Air Force (*Hukbong Himpapawid ng Pilipinas*) bought three F27-200MARs, two of which were written off in the space of a few months. One skidded into a pile of earth when landing in December 1988 and the other overran the runway into the sea in April 1989. Both accidents were fortunately without fatalities. The surviving aircraft serves with 221 Airlift Squadron 'Fokkers' at Mactan. The Pakistan Navy's three aircraft, plus one ex-PIA airliner, were upgraded with Thales OceanMaster radar and ESM system in 1993-99. Other customers for F27MARs were Angola, Nigeria and Peru,

A combat-capable variant was offered as the Maritime Enforcer, equipped for armed surveillance, ASW, anti-ship attack and other roles. Role equipment included a processor system for active and passive sonobuoys, a MAD and ESM system and an optional underwing searchlight. In 1984 Thailand bought six F27-200ME variants, which could be armed with depth charges, torpedoes and rocket pods. One Royal Thai Navy example was lost in January 1985 when it landed beside the Don Muang runway in bad visibility. It is believed that two remain in service.

Unbuilt F27 military derivatives included the Sentinel Elint version and the Kingbird AEW platform with a retractable ventral radar.

A development of the F27, the Fokker F50 flew on 28 December 1985. It shared only about

Fokker F50 Maritime Enforcer Mk. 2

Crew:	Seven; two pilots, one tactical coordinator, one acoustic sensor operator, one non-acoustic sensor operator and two observers
Length:	82ft 10n (27.40m)
Wingspan:	95ft 2in (29.00m)
Height:	27ft 4in (8.32m)
Empty weight:	29,352lb (13,314kg)
Max T/O weight:	47,500lb (21,545kg)
Powerplants:	Two Pratt & Whitney Canada PW125B turboprops rated at 2,500shp (13,134kg)
Max speed:	298mph (480km/h)
Service ceiling:	25,000ft (7,620m)
Range:	(ferry) 4,237 miles (6,820km); endurance 8hrs
Armament:	AGM-84 Harpoon ASMs, ASW torpedoes, mines, depth charges and rockets

20 per cent of components with its predecessor and had Pratt & Whitney Canada PW125B turboprops driving six-bladed propellers. More than 200 were sold to airlines around the world.

The second Fokker 50 (PH-LXX) was configured as a prototype for the Maritime Enforcer 2. The launch – and only – customer for the type was Singapore, which ordered five F50ME2S models.

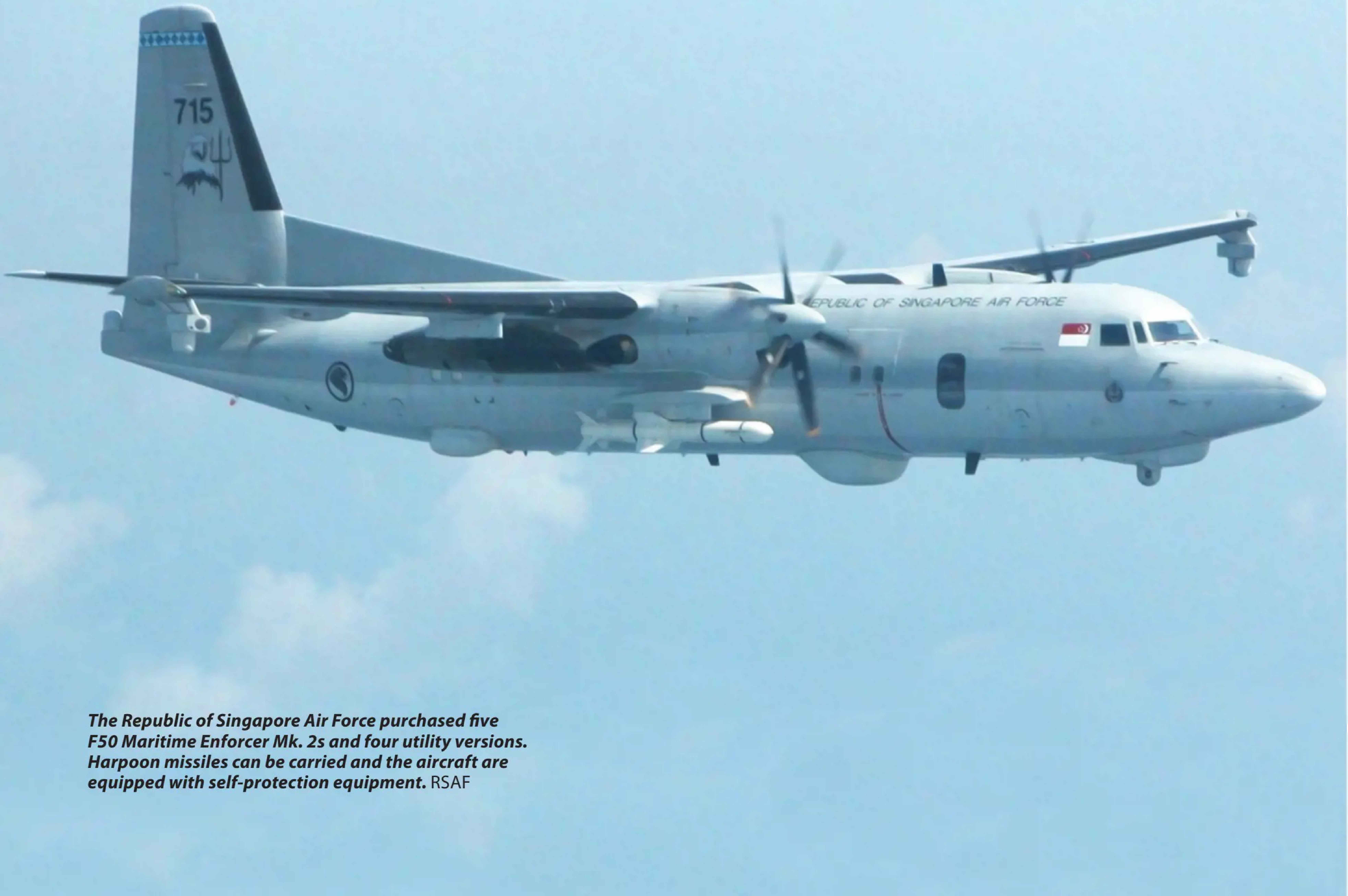
They were delivered 1993-95 to No. 121 Squadron based at Changi West, replacing Short Skyvans and are still in service. The pilots are RSAF personnel, while the systems operators are from the Royal Singapore Navy (RSN). The Fokkers are employed on protecting the sea lines of communication of Singapore, and conducting search and locate (SAL) missions and humanitarian assistance and disaster relief (HADR) operations.

Equipment included at delivery included a Texas Instruments APS-134 360-degree radar, a GEC FLIR, an internal MAD system and an acoustic processing suite. Some of the F50s were observed with a long underfuselage pod and a small chin radar.

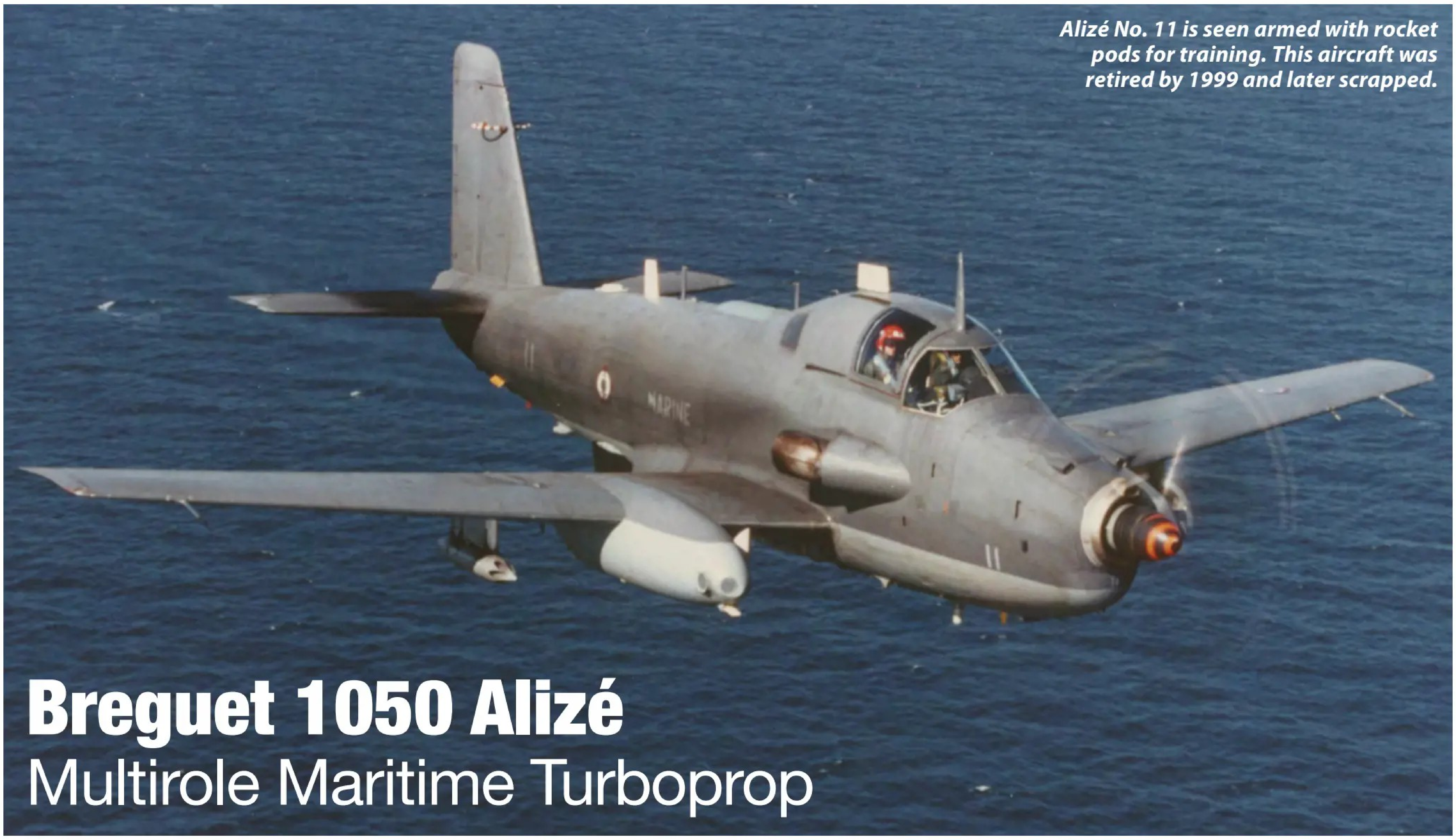
PH-EXF
IMPAPAWID NG PILIPINAS

Two of the three Philippines Air Force F27MAR aircraft were written off after accidents in 1988-89, including PH-EXF.

The F60 was a modernised development of the F50, but only four were built. Two of these were converted to MPA configuration with Telephonics APS-143B OceanEye radar and used by the Dutch Air Force in the Caribbean as maritime patrol aircraft from 2004 until sold to Peru in 2010 where the Navy used them for utility duties .



The Republic of Singapore Air Force purchased five F50 Maritime Enforcer Mk. 2s and four utility versions. Harpoon missiles can be carried and the aircraft are equipped with self-protection equipment. RSAF



Alizé No. 11 is seen armed with rocket pods for training. This aircraft was retired by 1999 and later scrapped.

Breguet 1050 Alizé

Multirole Maritime Turboprop

The long-lived Alizé (trade wind) fulfilled a similar function to the Fairey Gannet aboard France's aircraft carriers for more than 40 years.

The genesis of what was to eventually become the Alizé began in 1946 when the *Aéronavale* started looking at different indigenous and foreign options to replace the various types then in service. The French needs evolved progressively, but the advent of the anti-submarine Grumman Avenger purchased in 1951 to supplement the Curtiss SB2C-5 Helldiver dive-bombers gave more time to refine the requirement. The main threat perceived at the time came from Soviet surface vessels and submarines, and it was felt that a new, more potent aircraft than the Avenger was required to protect the French carrier groups. Breguet offered to use a hybrid configuration with an Armstrong-Siddeley Mamba turboprop in the nose combined with a Rolls-Royce Nene turbojet mounted in the tail, considerably boosting performance. This awkward configuration was tested in the Br. 960 Vultur, which first flew in August 1951. Two Vultur prototypes were built, but the *Aéronavale* progressively changed its requirement from a two-seat multirole naval attack aircraft to a three-seat anti-submarine design. The first Vultur prototype was transformed into a boundary layer control system test-bed while the second was modified to demonstrate some of the features to be adopted on the new aircraft.

The *Marine Nationale* soon gained approval to buy five prototypes of the Alizé, a new three-seat design powered by a Rolls-Royce Dart turboprop, and fitted with a retractable radome for a search radar which replaced the Nene turbojet. The first prototype of the Alizé (s/n 01) made its maiden flight on 5 October 1956 at Toulouse-Blagnac. In July 1957, the *Marine Nationale* ordered 75 Br.1050s, and, the same year, prototype 03 deployed to the Royal Aircraft Establishment at Bedford for catapult and arrested landing trials. The first landings and catapult shots were carried out on board the Royal Navy's aircraft carrier HMS *Eagle* in 1958.

The first production aircraft made its maiden flight in March 1959. The Indian Navy aircraft served with INAS 310 'Cobras' from Goa-Dabolin and the carrier *Vikrant*. When a ski-ramp was added to aid Sea Harrier operation in 1987, the five remaining Alizés moved ashore, with the last retired in late 1992.

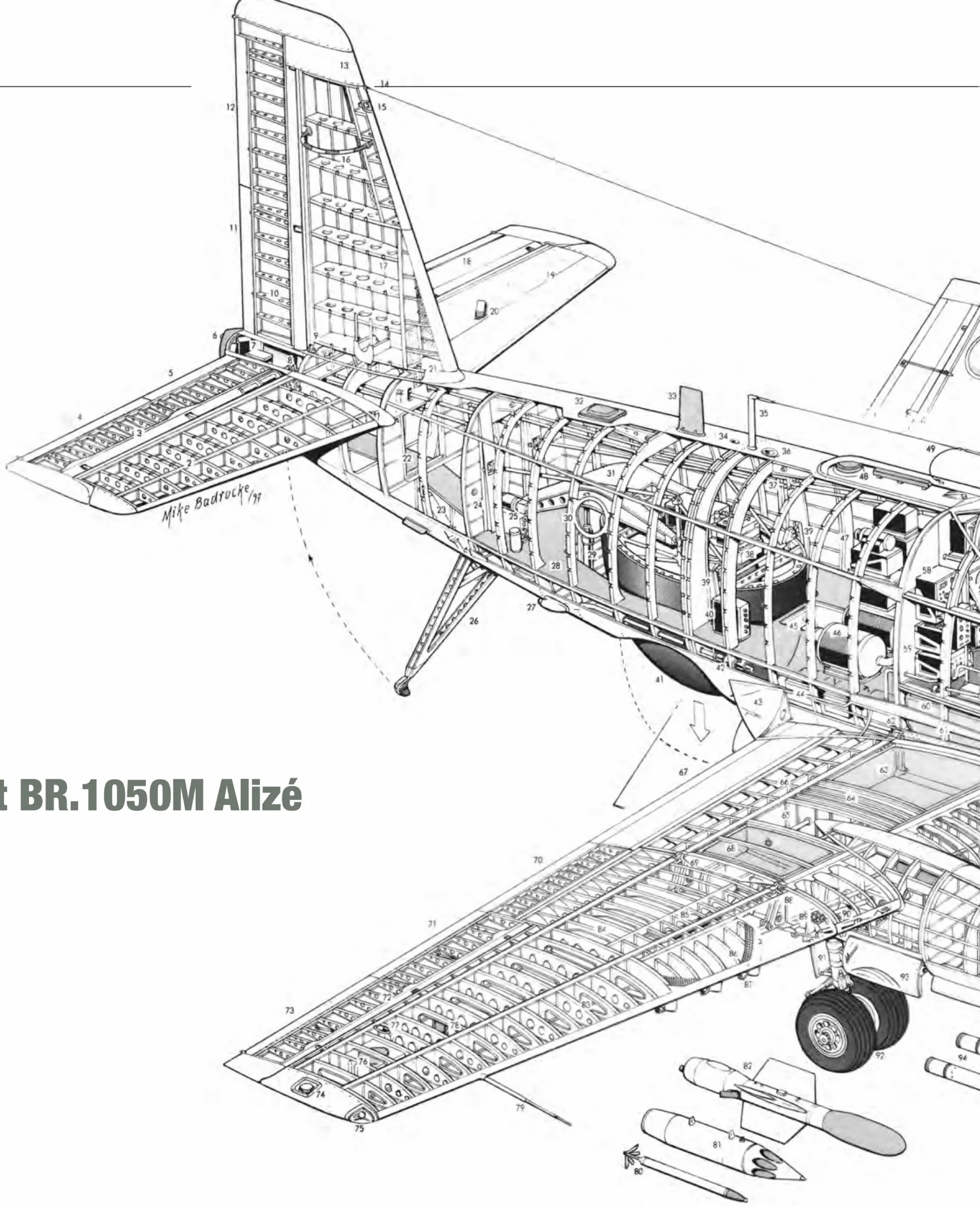
At the time, the Alizé was considered a state-of-the-art aircraft for carrier operations. It was rugged and reliable and it offered a significant improvement over is American predecessor of the World War Two era. Compared to the Avenger, the Alizé represented a giant step forward: it could effectively perform the hunter and killer roles simultaneously, and its powerful, fuel-efficient and reliable powerplant was a considerable improvement in terms of safety and endurance, giving excellent range and operating radius. The first production Alizé was delivered to *Flottille* 6F, at Hyères, in October 1959 and in 1960, both *Flottilles* 4F and 9F also received their first Alizés, bringing the carrier anti-submarine force to its full complement.

To carry out its missions, the Alizé was armed with depth charges and torpedoes in its internal weapon bay and with rocket pods and AS.12

Breguet 1050 Alizé

Crew:	Three; pilot, radar operator and navigator
Length:	45ft 6in (13.86m)
Wingspan:	51ft 2in (15.60m)
Height:	16ft 5in (5.00m)
Empty weight:	12,566lb (5,700kg)
Max T/O weight:	18,078lb (8,200kg)
Powerplants:	One Rolls-Royce Dart RDa.7 Mk.21 turboprop engine rated at 1,975hp (1,473kW)
Max speed:	323mph (520km/h)
Service ceiling:	20,505ft (6,250m)
Range:	(ferry) 1,785 miles (2,870km); endurance with auxiliary fuel 7hr 40min
Armament:	Depth charges and torpedoes in an internal weapon bay and rocket pods or AS.12 missiles attached to underwing hardpoints.

Breguet BR.1050M Alizé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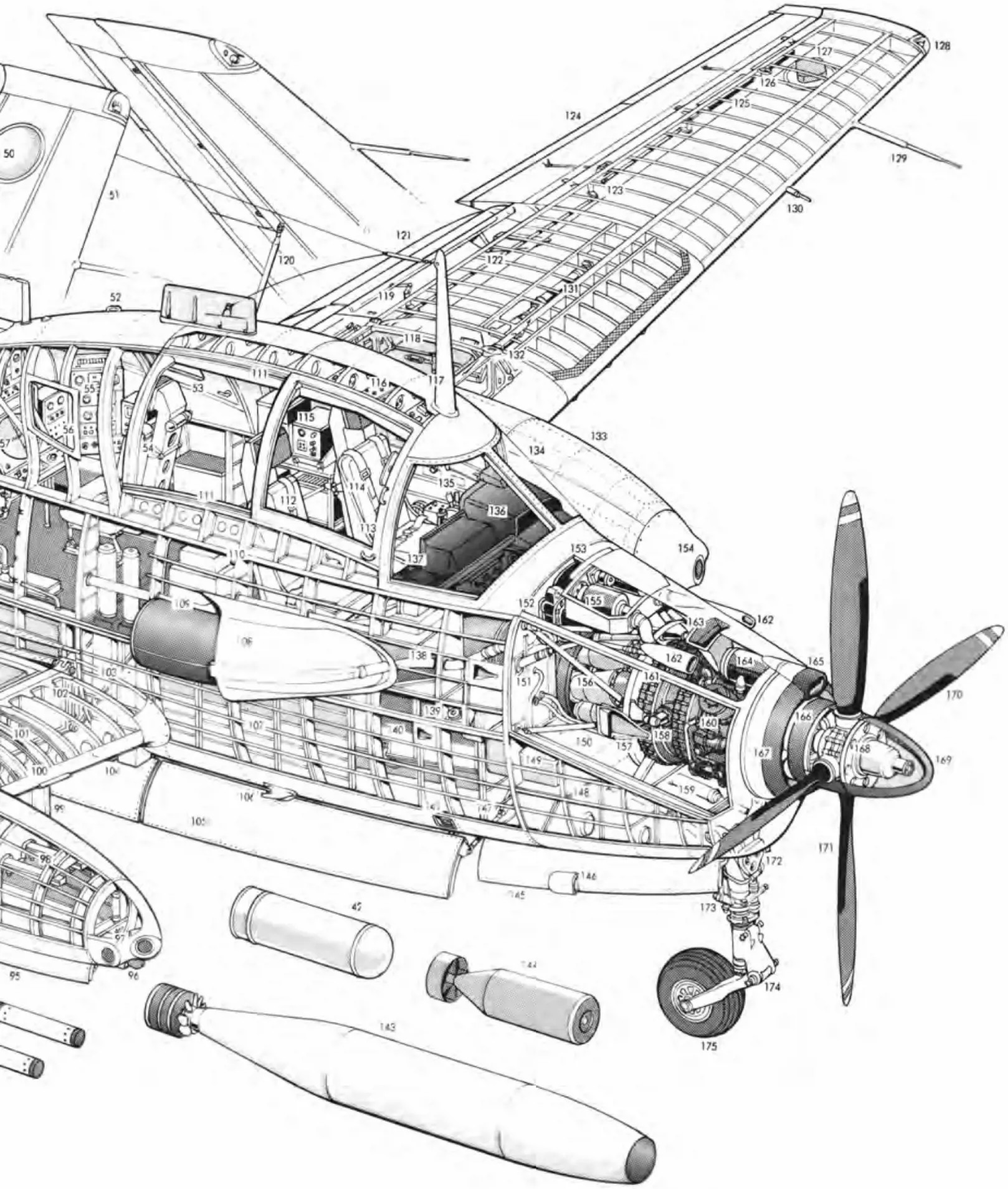
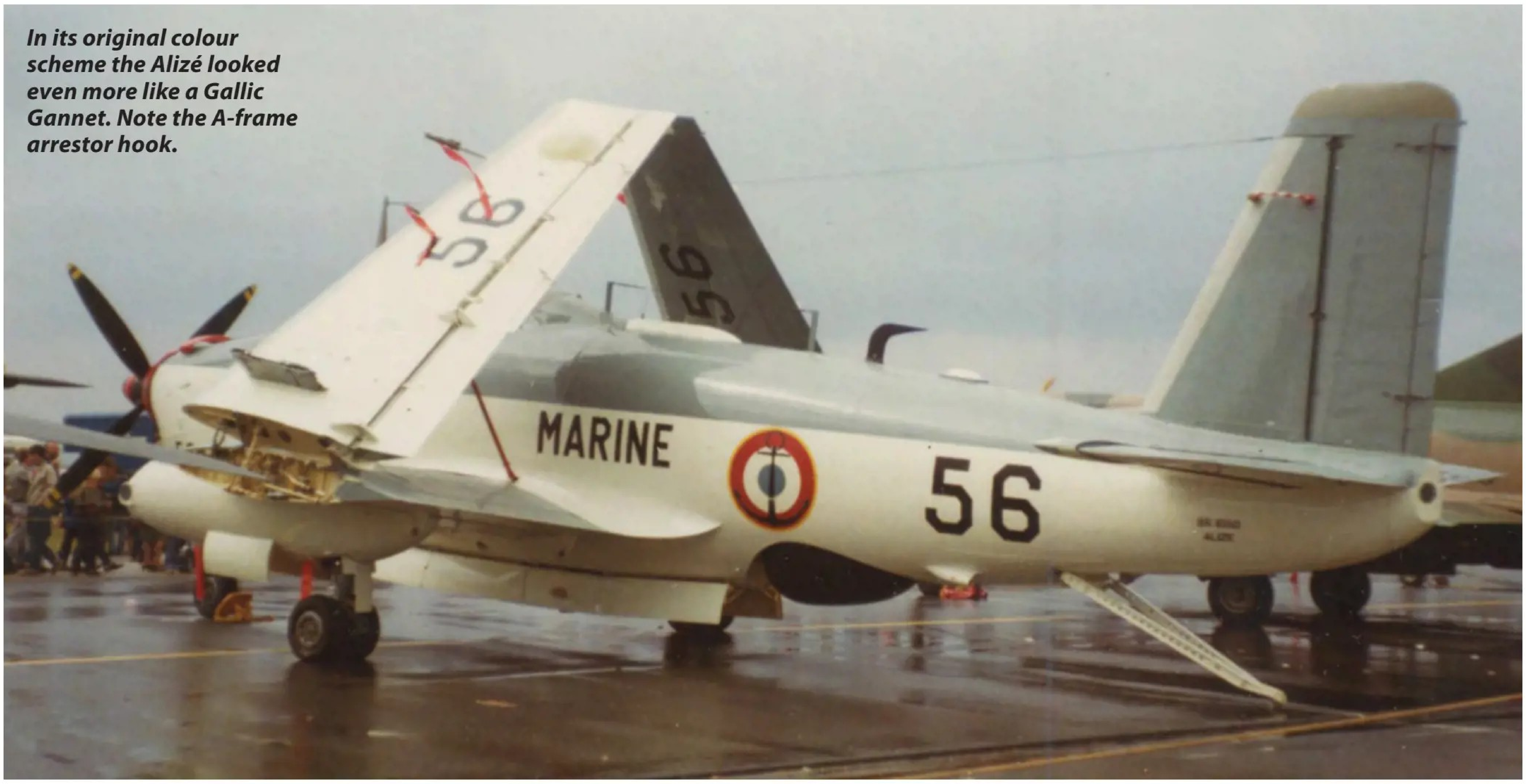
1 Elevator horn balance
2 Starboard tailplane rib structure
3 Starboard elevator
4 Spring tab
5 Elevator trim tab
6 Tail navigation light
7 Aft ARAR 12A ECM antenna
8 Rudder and elevator hinge control links
9 Fin rear spar attachment joint
10 Rudder rib structure
11 Rudder trim tab
12 Spring tab
13 Rudder horn balance
14 HF antenna cable
15 Approach light
16 VOR localiser antenna
17 Fin rib structure
18 Port elevator
19 Port tailplane
20 Radar altimeter receiver
21 Fin front spar attachment joint
22 Rear fuselage access
23 Hook hydraulic jack and damper
24 Rear fuselage bulkhead, radome hinge mounting
25 Radome extension control hydraulics and reservoir
26 Deck arrestor hook, lowered
27 Fuel jettison
28 Rear fuselage decking
29 Radome hydraulic actuator
30 Rear fuselage window panel
31 Radome hinge arm
32 ADF antenna
33 VHF antenna
34 Upper position light
35 Antenna mast
36 Anti-collision beacon
37 Tailplane control rods
38 Thomson DRAA Iguana radar
39 Radome guide rails
40 Junction box
41 Extending radome
42 Fuel jettison valve
43 Wing root trailing edge fillet
44 Underfloor avionics equipment
45 Rear fuselage access via weapons bay
46 Radar equipment modulators
47 Avionics equipment racks
48 DF loop antenna
49 Communications antenna
50 Underwing VHF homing antenna fairing
51 Wing folded position
52 Grab handle
53 Port side entry hatch
54 Radar operator's seat normally curtained from cockpit
55 Instrument console
56 rear window panel
57 Main radar display
58 Avionics equipment racks
59 Crew compartment rear bulkhead
60 Underfloor fuselage fuel tank
61 Lower main longeron



62 rear spar attachment joint
63 Wing inboard fuel tank
64 Double skin panel above tank bay
65 Dry bay
66 Flap shroud ribs
67 Inboard ruble-slotted flap segment
68 Outboard fuel tank bay
69 Rear spar hinge joint
70 Outboard ouble-slotted flap segment
71 Aileron trim tab
72 Starboard aileron rib structure
73 Spring tab
74 Remote compass transmitter
75 Starboard navigation light
76 VHF homing antenna
77 Starboard position light
78 Radar altimeter transmitting antenna
79 Pitot head
80 68mm rocket
81 Six-round rocket launcher
82 AS.12 air-to-surface missile
83 Leading edge rib structure
84 Outer wing fold panel two-spar an rib torsion box structure
85 Wing fold hydraulic jack
86 Aluminium honeycomb leading edge skin segment
87 Starboard outer wing pylons (3)
88 Front spar hinge joint
89 Main undercarriage pivot mounting
90 Hydraulic retraction jack
91 Shock absorber leg struct
92 Twin main wheels, forward retracting
93 Mainwheel doors
94 ARR 52 acoustic buoys
95 Sonobuoy bay doors
96 ILS glideslope antenna
97 Lateral and forward oblique ARAR 12A ECM antennas
98 Sonobuoy carrying bay and launchers
99 Wing inboard pylon
100 Stall buffet strip
101 Fixed inboard wing panel leading edge structure
102 Front spar root joint
103 Spar carry-through structure, arched above weapons bay
104 Twin marker launchers
105 Weapons bay doors
106 Catapult strop hook
107 Forward fuselage frame and stringer structure
108 Exhaust duct fairing, starboard only
109 Engine exhaust duct
110 Cockpit sidewall structure
111 Sliding entry hatch rails
112 Tactical navigator's seat
113 Starboard sliding cockpit entry hatch
114 Pilot's seat
115 Avionics equipment
116 Overhead switch panel
117 HF antenna mast
118 Port outboard wing tank
119 Flap control linkage
120 Wing fold jury strut
121 Port double slotted flap, extended
122 Flap external hinge
123 Aileron hinge control linkage
124 Port aileron with trim and spring tabs
125 Aileron mass balance weight
126 Port position light
127 VHF homing antenna
128 Starboard navigation light
129 Starboard pitot head
130 Incidence probe
131 Wing fold hydraulic jack
132 Port wing fold hinge joint
133 Port undercarriage and sonobuoy bay fairing
134 Windscreen panels
135 Engine throttle and propeller control levers
136 Instrument panel shroud
137 Tactical navigator's display
138 Engine bay venting air exhaust duct
139 Water/methanol filler
140 Internal weapons bay
141 Ground power socket
142 175kg mine (3)
143 L-4 torpedo
144 160kg depth charge (3)
145 Nosewheel doors
146 Venting air scoop
147 Weapons bay door hydraulic jack
148 Nosewheel bay structure
149 Water/methanol tank
150 Engine bay fireproof deck
151 Crew compartment fireproof front bulkhead
152 Accessory equipment gearbox
153 Windscreen rain dispersal air duct
154 Port lateral and forward oblique ARAR
12A ECM antennas
155 Alternator. Generator to port
156 Engine bearer struts
157 Venting air intake
158 Main engine mounting
159 Nosewheel hydraulic retraction jack
160 Rolls-Royce Dart R.Da Mk.21 turboprop engine
161 Engine bay access hatch, port and starboard
162 Alternator and generator cooling air intakes
163 Oil cooler exhaust
164 Oil cooling radiator
165 Cooling air intake
166 Engine annular air intake
167 Intake lip de-icing boot
168 Propeller hub pitch change mechanism
169 Spinner
170 Four-bladed constant-See propeller
171 Blade root de-icing boot
172 Deck approach lights
173 Nosewheel steering jack an linkage
174 Levered suspension nose undercarriage
175 Nosewheel, aft retracting

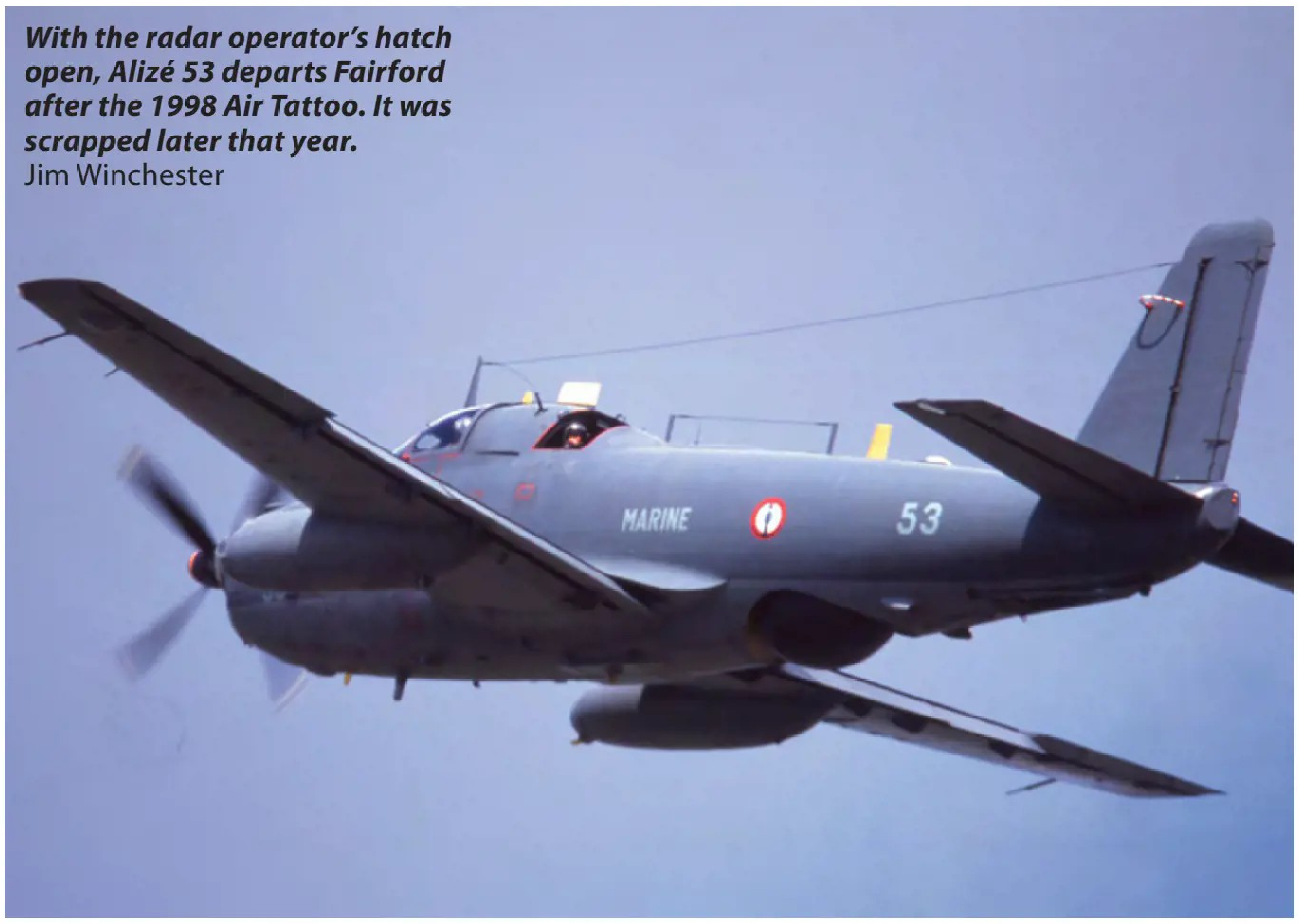


In its original colour scheme the Alizé looked even more like a Gallic Gannet. Note the A-frame arrestor hook.

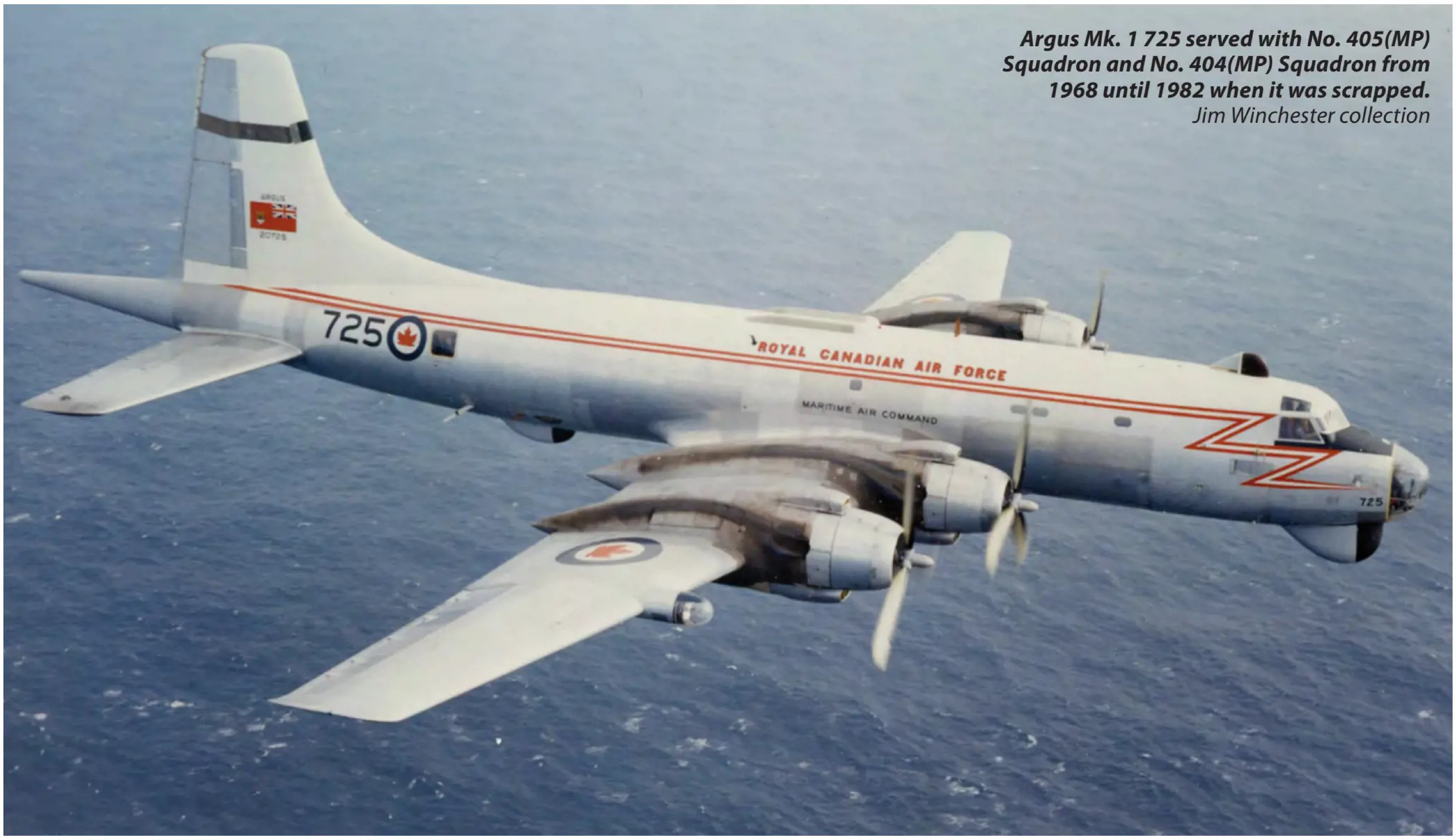
missiles attached to underwing hardpoints. It also carried sonobuoys and smoke markers. The type mainly flew from the carriers Clemenceau and Foch. Over time its ASW role was progressively taken over by helicopters fitted with a dunking sonar, however, and the Alizé then mainly performed SUCAPs (Surface Unit Combat Air Patrols) and intelligence gathering missions ahead of the carrier strike group in the later years of its operational career. It could also guide anti-ship strikes carried out by Super Etendards armed with AM39 Exocet missiles. Other roles performed by the Alizé included communications relay, electronic intelligence, acting as on-site commander for search and rescue/combat search and rescue missions (SAR/CSAR) flown by Super Frelons, maritime surveillance and pollution control.

In 1977, with 40 Alizés still in service, it was decided to modernise the type to extend its operational effectiveness into the 1990s. Eventually, only 28 aircraft were involved in the upgrade programme which encompassed the adoption of a DRAA-10A *Iguane* radar, an ARAR 12A electronic surveillance system to detect electromagnetic emissions, a new Omega Equinoxe navigation system, and a state-of-the-art ARR sonobuoy data processor. However, nothing was done to significantly improve the anti-submarine warfare capabilities of the aircraft as it was felt that modern, nuclear-powered submarine could better be dealt with by helicopters equipped with sonars, and by shore-based maritime-patrol aircraft. In service, the modernised aircraft were known as ALM (for *ALizé Modernisé*), and the first aircraft was delivered back to *Flottille* 6F in 1983. The modernisation of the last aircraft was completed the following year.

In 1996, a final modernisation programme called ALH (*ALizé mis à Hauteur,* or upgraded Alizé) was initiated for nine aircraft, involving the adoption of a new autopilot, and of a Chlio FLIR mounted in the port undercarriage sponson, with a screen for the navigator. This FLIR considerably facilitated night identification of unknown vessels at standoff distances. These turrets were later recovered and transferred to Falcon 50s upgraded to SURMAR (surveillance maritime) standard for service with *Flottille* 24F, at Lann-Bihoué. On September 15, 2000, as the French Navy was transitioning from the *Clemenceau*-class carriers to the *Charles de Gaulle*, the Alizés of *Flottille* 6F were finally withdrawn from service, bringing to a halt an eventful period of 41 years of service.



With the radar operator's hatch open, Alizé 53 departs Fairford after the 1998 Air Tattoo. It was scrapped later that year.
Jim Winchester


Argus Mk. 1 725 served with No. 405(MP) Squadron and No. 404(MP) Squadron from 1968 until 1982 when it was scrapped. *Jim Winchester collection*

Canadair Argus
Northern Guardian

Based on the Bristol Britannia airliner, the Argus replaced the Lancaster and Neptune in Canada's maritime patrol squadrons.

A 1952 RCAF requirement led to a contract award to Canadair in April 1954 for a development based on the Britannia turboprop, although Lockheed had offered a variant of their Constellation. Initially known as the 'Britannia Maritime Reconnaissance', the CL-28 Argus was a unique hybrid that employed the wings, tail surfaces and undercarriage of the Britannia married to a completely new unpressurised fuselage of Canadian design and powered by Wright R-3350 turbo-compound piston engines. Specifications for metal gauges and fasteners were changed to American standards. The unit cost was Can $5,513m.

The first flight was on 28 March 1957. A total of six development aircraft were used for service trials and evaluation before the type entered service as the CP-107 Argus in May 1958 with No. 404 Squadron at Greenwood, Nova Scotia The serial numbers 20710–20742 were allocated. With unification of the Canadian Armed Forces in February 1968, the serial numbers were changed to 10710–10726 and 10728–10742. During the operational life of the Argus, the commanding headquarters changed name from RCAF Air Command to Canadian Forces Maritime Air Group and then Air Command.

One of the most effective antisubmarine warfare (ASW) aircraft of its day, the Argus was a mainstay for the RCAF in the maritime role. The principal difference between the Mk.1 and Mk.2 was different navigation, communication and tactical-electronic equipment fitted internally. Externally, the Mk. 2 exhibited a redesigned smaller nose radome and additional ECM antennas above the fuselage. The Mk. 2's radar was the American APS-20, while the Mk. 2 used the British ASV-21.

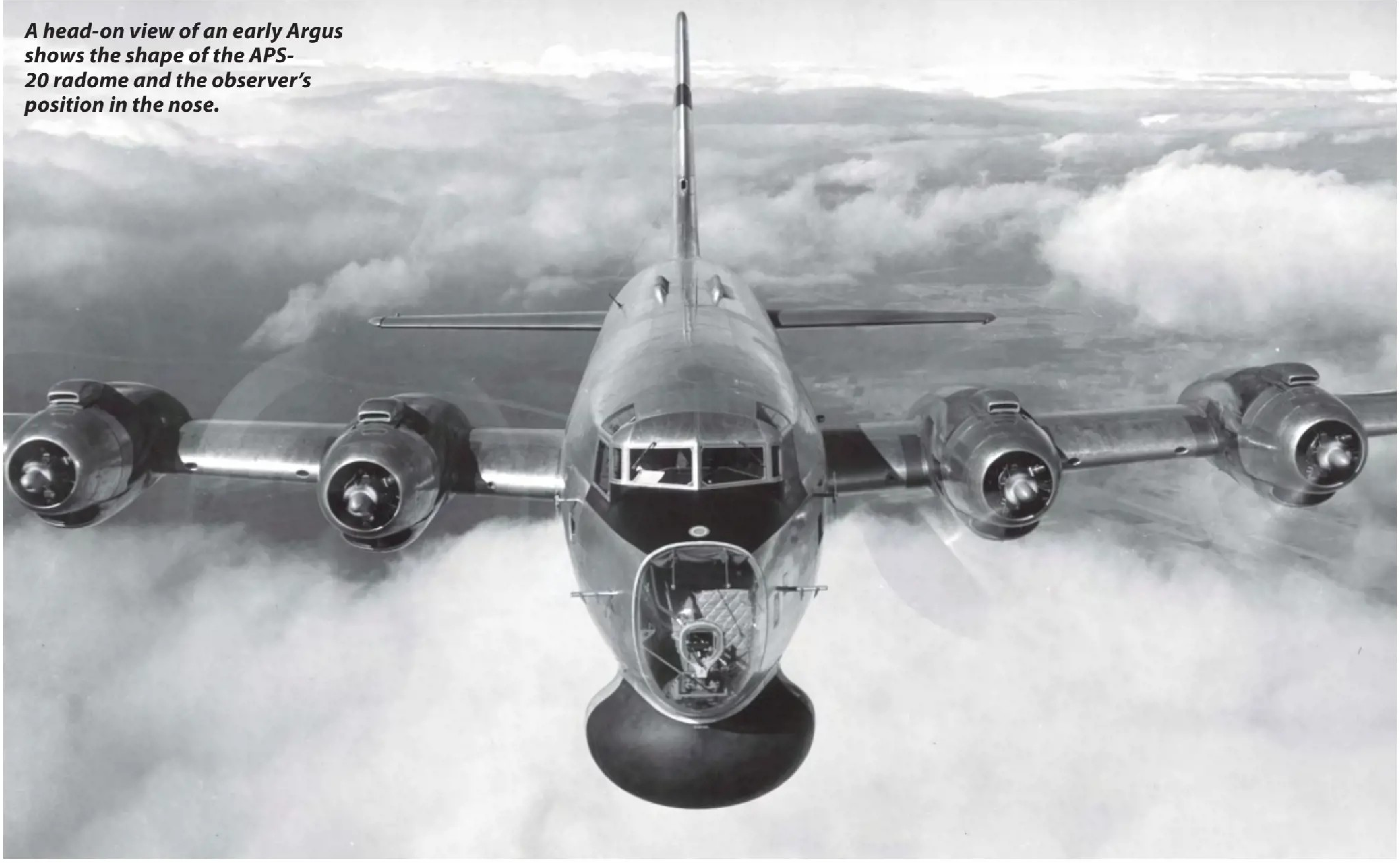
The Argus also had a wing-mounted 70m-candlepower searchlight, which could illuminate a submarine's periscope up to 1.7 miles (2.8km) away. There were weapons bays forward and aft of the wing, each two 18ft (5.5m) long. These were capable of carrying torpedoes, bombs, mines and Mk. 54 depth charges.

The piston engines gave the Argus very long endurance, aided by including rest space and a galley for a relief crew. Although it lacked the dash speed of a turboprop or jet, the Argus could patrol for over 24hrs if necessary. They made several significant flights, including a Canadian endurance record of 30hr 20min and a flight from Hawaii to North Bay, Ontario, a distance of 4,570 miles (7,355km) in 20hr 10min. During the Cuban Missile Crisis, Argus crews flew six hours to their mid-Atlantic station, spent eight hours on patrol then returned home.

Production amounted to 13 Mk. 1s and 20 Mk. 2s, the last of which was delivered in July 1960. Arguses equipped Nos. 404, 405, 407, 415, and 449 Squadrons, No. 2(M) OTU and the Maritime Proving and Evaluation Unit (MPEU).

As well as searching for Soviet submarines, the Argus squadrons flew anti-pollution and anti-smuggling patrols, fisheries protection missions and Arctic sovereignty patrols. A secondary transport role saw the Argus carry up to 40 passengers on occasions. For search and rescue duties the Argus could carry MA1 gear, which consisted of two ten-man dinghies connected by an 800ft (244m) rope and with survival stores in attached bags.

One notable mission was the effort to aid survivors of the cruise ship MS *Prinsendam*, which sank off Alaska in October 1980. Arguses provided on-scene coordination and

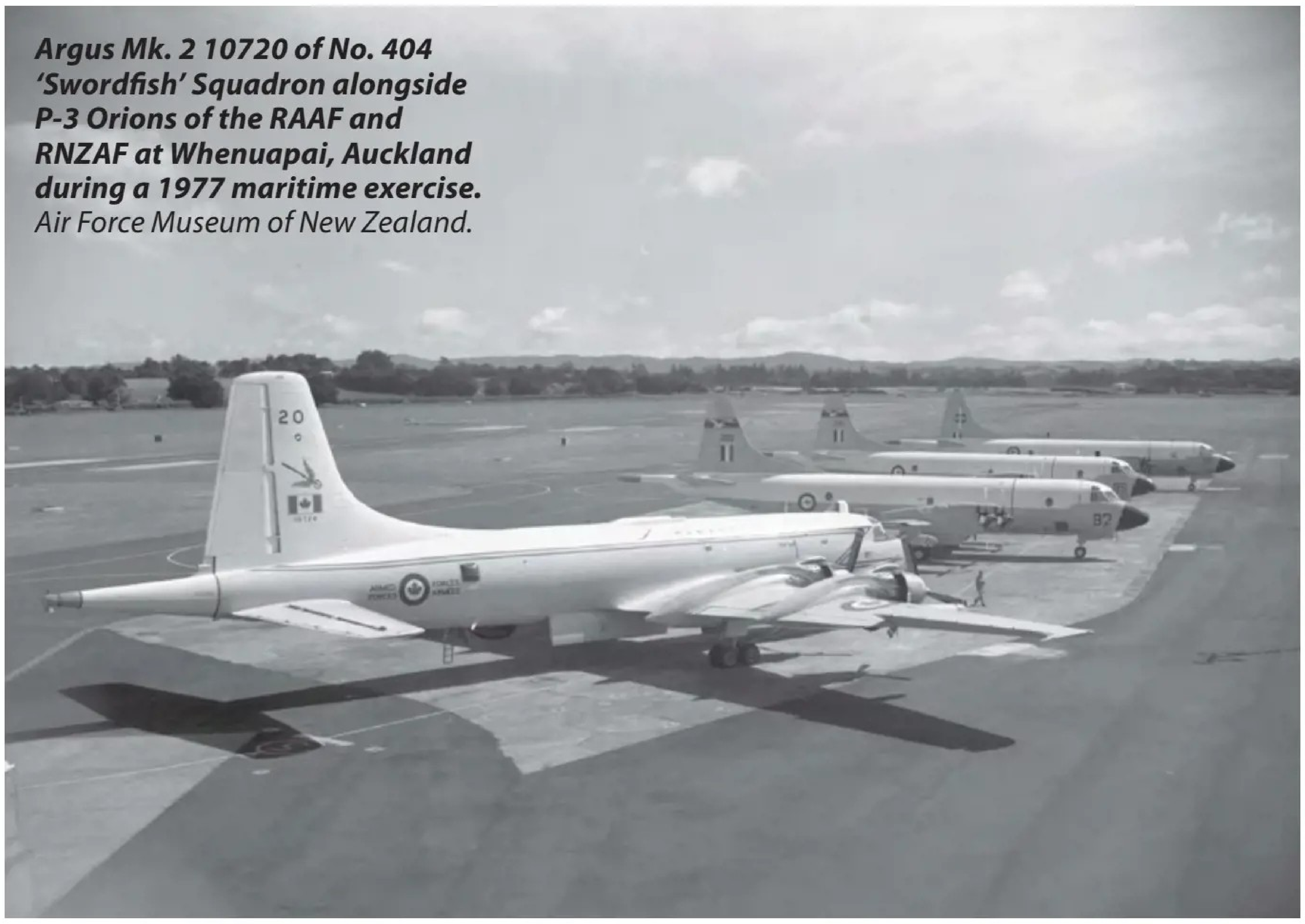


A head-on view of an early Argus shows the shape of the APS-20 radome and the observer's position in the nose.

communications relay for the rescue of 519 survivors by ship and helicopter. In December 1982 an Argus discovered the site of a Beech 18 crash after 31 days, by which time the sole survivor had resorted to cannibalism.

There were two major accidents in service. Argus Mk. 2 20727 crashed in the Caribbean in March 1965 when a wingtip struck the water after it overflew a Royal Navy submarine during a night exercise, killing 16, and 10737 hit a parked civil Electra in a landing accident in March 1977 with three fatalities.

No. 415 Squadron, based at RCAF Summerside, Prince Edward Island, flew the last operational Argus sortie on 24 July 1981. The last Argus to fly was 10742, flown to the Canada Aviation and Space Museum, Ottawa, in February 1982. Other survivors are 10712 at the Comox Air Force Museum, 10732 at the CFB Trenton RCAF Memorial Museum, and 10739 at CFB Summerside.



Argus Mk. 2 10720 of No. 404 'Swordfish' Squadron alongside P-3 Orions of the RAAF and RNZAF at Whenuapai, Auckland during a 1977 maritime exercise. *Air Force Museum of New Zealand.*

Canadair Argus Mk. 1/2

Crew:	15; two pilots, flight engineer, navigator, radio operator and relief crew of four, plus six operators for ASW equipment
Length:	128ft 3in (39.09m)
Wingspan:	142ft 4in (43.38m)
Height:	36ft 9in (11.2m)
Empty weight:	81,000lb (36,744kg)
Max T/O weight:	148,000lb (67,192kg)
Powerplants:	Four Wright R3370 TC981 piston engines rated at 3,700hp (2,760kW)
Max speed:	288mph (463km/h)
Service ceiling:	24,200ft (7,376m)
Range:	5,090 miles (8,190 km); endurance: 26.5hr
Armament:	8,000lb (3,629kg) of torpedoes, bombs, depth charges or mines

A P-3A Orion of VP-49 'Woodpeckers' patrols the Atlantic in January 1964. The squadron transitioned from the SP-5B Marin that year and moved to NAS Patuxent River, Maryland. *US Navy*

Lockheed P-3 Orion

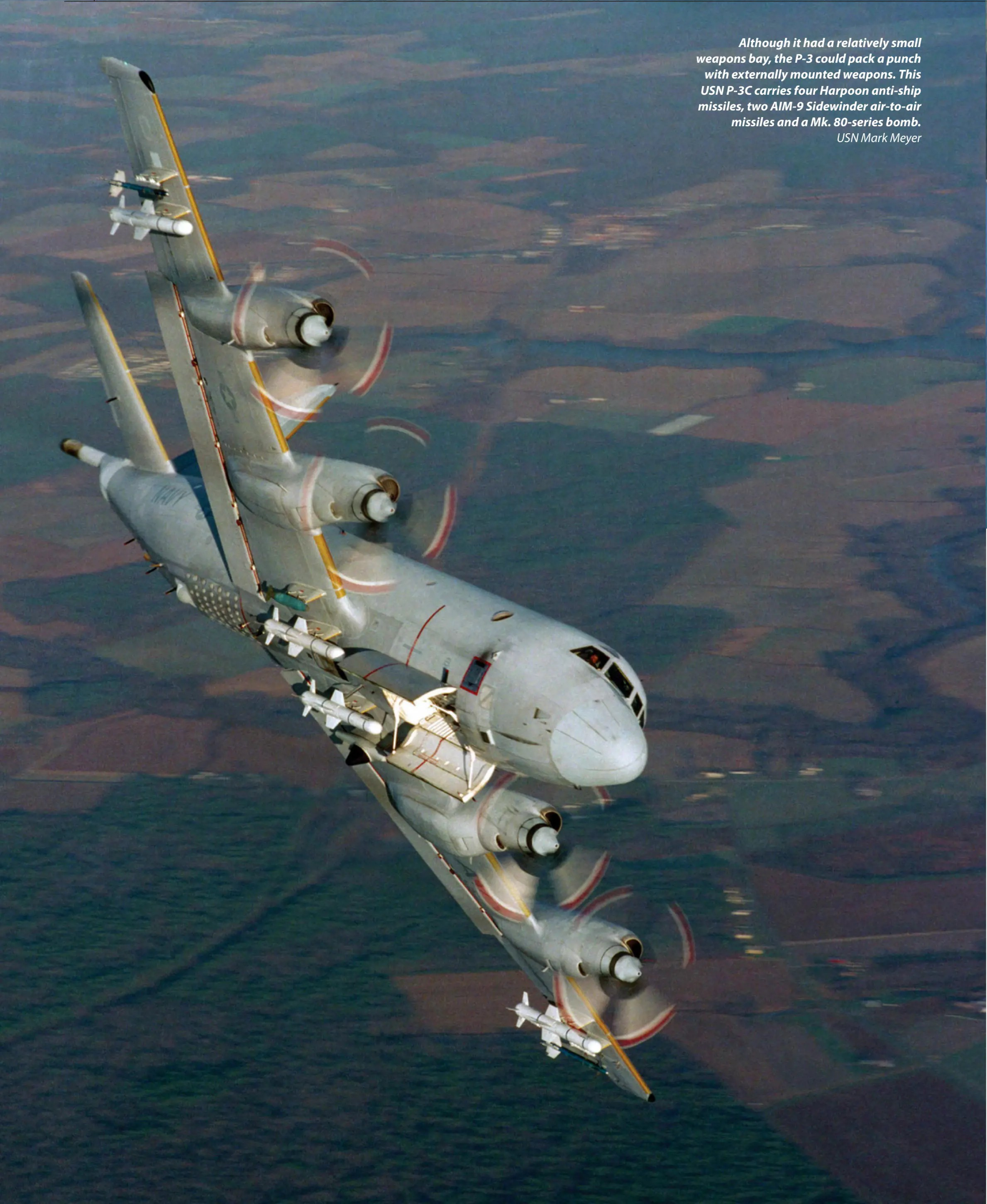
The World's Most Popular MPA

Mention maritime patrol aircraft and the Lockheed P-3 will probably first come to mind. The Orion has roamed the world's oceans for over six decades and modernised versions will continue do so for many years to come.

In response to an August 1957 request for proposals, Lockheed submitted a derivative of the L-188 Electra airliner, then under development. Like the de Havilland Comet, which evolved into the Nimrod, the Electra would have several structural failures in early service, but when the airframe was strengthened, went on to a successful career.

An aerodynamic prototype converted from the first Electra flew on 19 August 1958, followed by the fully equipped YP3V-1 (148276) on 25 November 1959. The Orion's fuselage was shorter than the Electra's with a beefed-up wing structure for low-level flying. Navy evaluation began in June 1961 and the first production P3V-1 was delivered to VP-8 in August 1962 just in time to be redesignated P-3A. The squadron was soon on operational

The Republic of Korea became the last customer for new-build Orions, when it ordered eight in 2006. P-3C Update II+ 950901 was the first completed at Lockheed Martin's Marietta Georgia facility. *Jim Winchester collection*



Although it had a relatively small weapons bay, the P-3 could pack a punch with externally mounted weapons. This USN P-3C carries four Harpoon anti-ship missiles, two AIM-9 Sidewinder air-to-air missiles and a Mk. 80-series bomb.
USN Mark Meyer

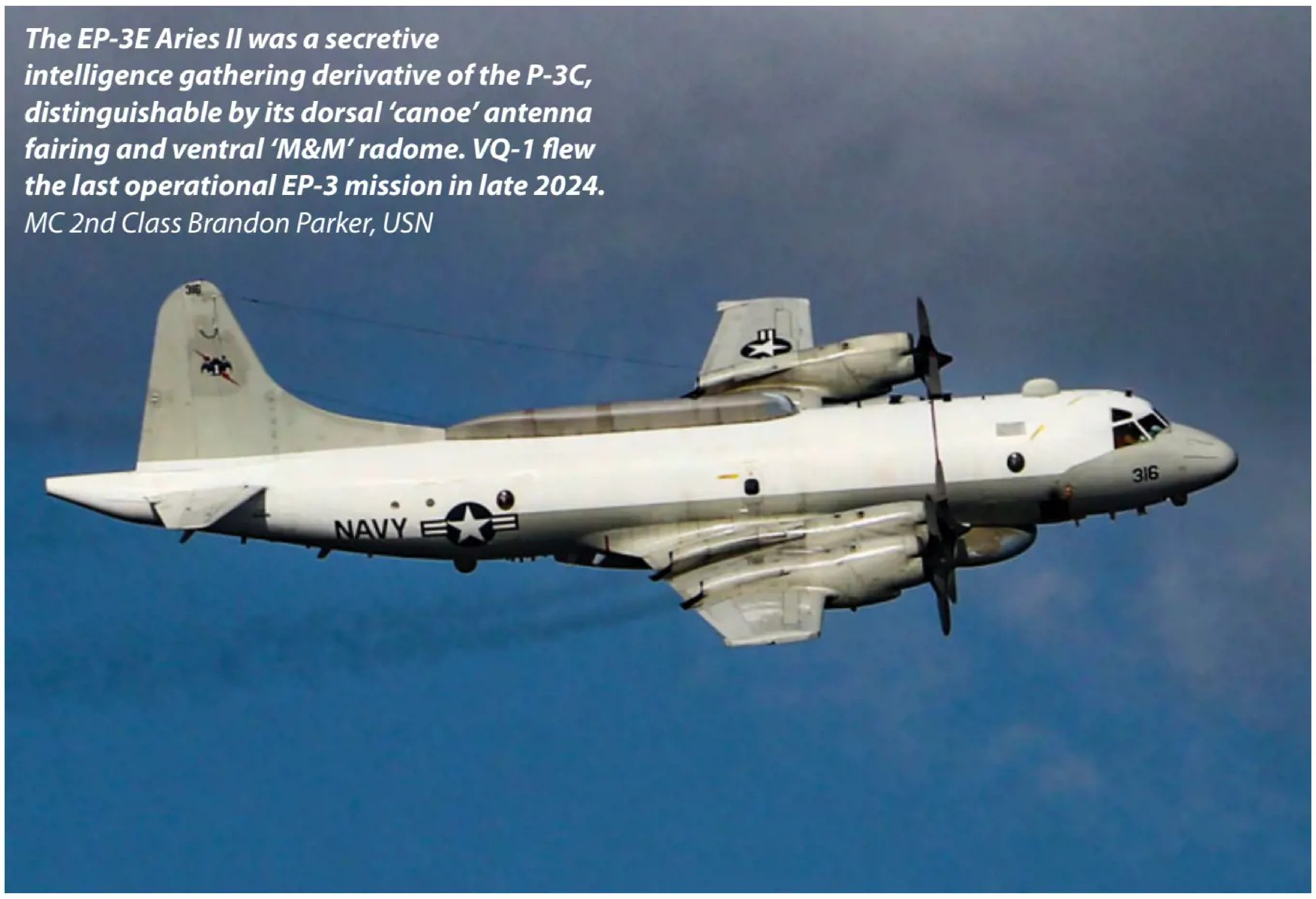
The first export customer for the P-3 was the RNZAF, which operated the type from 1966 until 2023. Over that time there were many structural and equipment upgrades including two generations of EO turret. *AC Louisa Grant, RNZAF*

JMSDF Orions lost their colourful markings some years ago, but still keep a smart appearance. This pair of Kawaski-built P-3Cs belongs to 203 Kokutai of the Shimofusa Training Air Group. *JMSDF*

service, contributing to the blockade against Cuba during the Missile Crisis that October alongside VP-44, the second P-3 unit to form at NAS Patuxent River, Maryland.

P-3s deployed to Vietnam from February 1965, keeping submarines away from the carriers and other ships of Task Force 77, flying night radar surveillance sorties and intercepting infiltrating cargo ships as part of Operation Market Time, replacing Neptunes. One P-3B of VP-26 was shot down by a Cambodian gunboat in April 1968 during this operation.

Production of P-3As for the USN reached 158, before switching to the P-3B, of which 125 were completed at Burbank, California. The B saw a change to the T56-A-14 engine, which was more powerful and did not require water/methanol injection, addition of an auxiliary power unit (APU) and deletion of the ASR-3 'Sniffer'. Computer processing capability was increased to handle the output from eight sonobuoys rather than four.



The EP-3E Aries II was a secretive intelligence gathering derivative of the P-3C, distinguishable by its dorsal 'canoe' antenna fairing and ventral 'M&M' radome. VQ-1 flew the last operational EP-3 mission in late 2024.
MC 2nd Class Brandon Parker, USN

The P-3C flew in September 1968. Although the 'Charlie' was the last major US production model, there were many variants and sub-variants, identified by the status of their ASW systems. Update II, for example, introduced an infrared detection system (IRDS) in a retractable undernose turret,and the P-3C AIP had improved anti-surface warfare capabilities.

The first (unacknowledged) export operator was the Republic of China Air Force (RoCAF), which operated two CIA-owned P-3As on electronic surveillance missions against the People's Republic in 1966-67. The Royal New Zealand Air Force (RNZAF) was the first to purchase Orions, five P-3Bs joining No. 5 Squadron at Whenuapai in 1966. Another ex-RAAF P-3B arrived in 1985 and all were put through Project Rigel to update their operators stations and add IRDS. Now known as P-3Ks, they were further updated in 2010-2014 to become P-3K2s with Elta EL/M-2022A radar and other improvements. A programme to improve their weapons capabilities was cancelled and they were only equipped with Mk. 46 torpedoes and Mk. 82 bombs by the time they were finally retired in January 2023.

Australia bought ten P-3Bs in 1968 for No. 10 Squadron and ten P-3C-IIs for No. 11 Squadron, also at RAAF Edinburgh, South Australia in 1975. The Bs were exchanged for P-3C-II½s in 1984, and three Bs were bought as 'bounce bird' trainers. In 1997 a major upgrade began to bring most to AP-3C standard with EL/M-2022A radar and a new acoustic system. Two were equipped as AP-3C(EW) SigInt platforms. The last of the fleet was retired in December 2023.

Norway was another early customer, buying five new P-3Bs in 1968 for 333 Skvadron and two ex-USN P-3Bs in 1980. Three years later, one dropped depth charges on a suspected Soviet submarine in a Norwegian fjord. In 1987 another had a minor collision with a Sukhoi Su-27 *Flanker* but returned safely. Portugal bought five in 1989, while the remains two became P-3Ns with ASW gear removed but other equipment including SLAR installed Four P-3C Update IIIs were bought new and were put through an Update Improvement Programme in 1997-2000, becoming P-3C UIPs. The RNoAF retired the P-3 in 2023.

Spain's first seven Orions were P-3As purchased in 1973. One crashed in 1977 but four more were leased in 1979. They were returned when five P-3Bs were bought from Norway in 1988. In 1994 the P-3 unit, *Escuadrón* 221, moved from Jerez to Moron Air Base. The aircraft were upgraded to P-3M standard in the late 2000s and retired in December 2022 without a replacement platform in service.

Iran's P-3Fs were essentially P-3Cs with P-3B features such as searchlights. One crashed in the US, but the rest were delivered in 1975. Three more were ordered in 1978, but redirected to the USN after the 1979 Revolution. Serviceability of the IRIAF's fleet dwindled to one airworthy aircraft, but as many as three have been kept operational by spares supplied under the Iran-Contra deal in the 1980s

Japan was (and is) by far the biggest non-US operator. An initial order of 45 P-3C-II½s was made in 1978 with the first three completed at Burbank, the next four in Japan from kits and all subsequent examples from a final total of 101 by Kawasaki Heavy Industries. They were issued to five air wings and one training group of the JMSDF. The P-3Cs were progressively updated to the latest standard and several distinct Japanese variants were created; an EP-3 Elint platform, UP-3C test evaluation aircraft, UP-3D electronic warfare training aircraft and UP-3E image intelligence gathering aircraft. Three Japanese (and six USN) P-3s were badly damaged when a hangar roof collapsed at Atsugi after heavy snowfall in February 2015. Japan's P-3s are slowly being replaced by the Kawasaki P-1.

A distinctive feature of the RCAF's CP-140 Aurora is the ESM pods on the wingtips. This example was participating at the Royal International Air Tattoo in 2019.
Jim Winchester

Canada's 18 P-3s entered service from 1980 after a long selection process, and internal

140112
RCAF ARC

changes which saw them designated CP-140 Aurora. They incorporated a totally different suite of mission equipment to other P-3s with much Canadian content. Three more aircraft with a more limited equipment fit were purchased in 1993 as the CP-140A Arcturus and used for surface surveillance and training until retired in 2010. The Auroras serve with 19 Wing at Comox, British Columbia and 14 Wing at Greenwood, Nova Scotia. Some aircraft have been upgraded with a large SATCOM dome on the upper fuselage.

The Netherlands bought 13 P-3C-II1/2 Orions, which joined 320 Squadron at Valkenburg from 1982, with one aircraft normally detached to Keflavik, Iceland. In 2000 plans were announced to reduce the fleet to ten aircraft upgraded to P-3C CUP (Capability Update Program) standard but in 2006 the aircraft were sold to Germany.

Portugal bought six ex-RAAF P-3Bs from Lockheed in 1985 and updated them to P-3P configuration with some P-3C-II features and some local modifications, including AAS-36 IRDS and an ESM system with a dorsal radome and extra operator. They serve with *Escuadra* 601 at Montijo.

The first Latin American user was Chile, which took delivery of eight P-3As in 1994. Originally operated without ASW gear, four have since been equipped with local systems as the P-3ACH.

The Royal Thai Naval Air Division began Orion operations with two unmodified ex-USN P-3As purchased for training in 1994. A further three were modified to P-3Ts, two of them with IRDS and Harpoon capability and one as a UP-3T

Iran has managed to keep at least some of its five P-3Fs flying despite US sanctions since 1979. In 2019 this one made a flyby of American ships in the Gulf of Oman. *US Navy*

transport. These serve alongside the Fokker F27MEs of 102 Squadron at U Tapao.

Just as P-3 production was coming to an end, South Korea ordered eight P-3C-III+ Orions in 1990. Seoul financed the move of the final assembly line to Marietta, Georgia. A further eight Orions, designated P-3CK, were upgraded from P-3Bs by Korean Aerospace Industries (KAI) and entered service with 61 Patrol Air Group at Jeju in 2010.

Having retired its SP-2H Neptunes during the Falklands War, and being refused P-3Bs from the US, Argentina modified six commercially acquired L-188 Electras as a stopgap solution. After participating in Operation Desert Storm, export restrictions were relaxed and Argentina was allowed to purchase six P-3Bs. These arrived in 1997-99 and equipped *Escuadra Aeronava*l 6 at Almirante Zar Air Base.

Pakistan's three P-3C-II¾s were delivered to Jacksonville for training in late 1990, but disputes over the country's nuclear weapons programme saw them put into storage until 1996-97. Only in January 1999 were they declared operational with the Navy's 28(MS) Squadron at Mehran. One was lost in an accident that December, while the others were upgraded and then destroyed in a 2011 attack on their base. A further seven were delivered and brought up to the same standard.

In 1995 Greece purchased six surplus P-3Bs, which are owned by the Hellenic Navy but operated by Air Force crews, although will move to HAF control when a long-delayed upgrade to P-3HN standard is completed. Only one is currently believed active with 353 MNAS at Elefsis, while one is under upgrade and three others are stored awaiting modification.

Having requested 15 P-3Cs in 1998, Brazil was sold eight P-3As and four more for spares the following year. A training programme began with the Portuguese Air Force, and then stopped before it was announced the aircraft would be modernised before delivery. The P-3AM is equipped with the EADS/CASA Fully Integrated Tactical System (FITS) and Thales flightdeck instruments. They entered service with 4°/7°GAV at BA Santa Cruz from 2010, but by 2021 all but three were grounded awaiting wing replacements. The first re-winged aircraft flew in May 2024.

The first non-US Orion operating nation is also the newest. Taiwan bought 12 P-3Cs from US surplus in 2007, which were modernised and overhauled by Lockheed Martin and began entering service in 2013. The RoCAF's 33rd Anti Submarine Warfare Squadron at Pintung North operates them on behalf of the Navy.

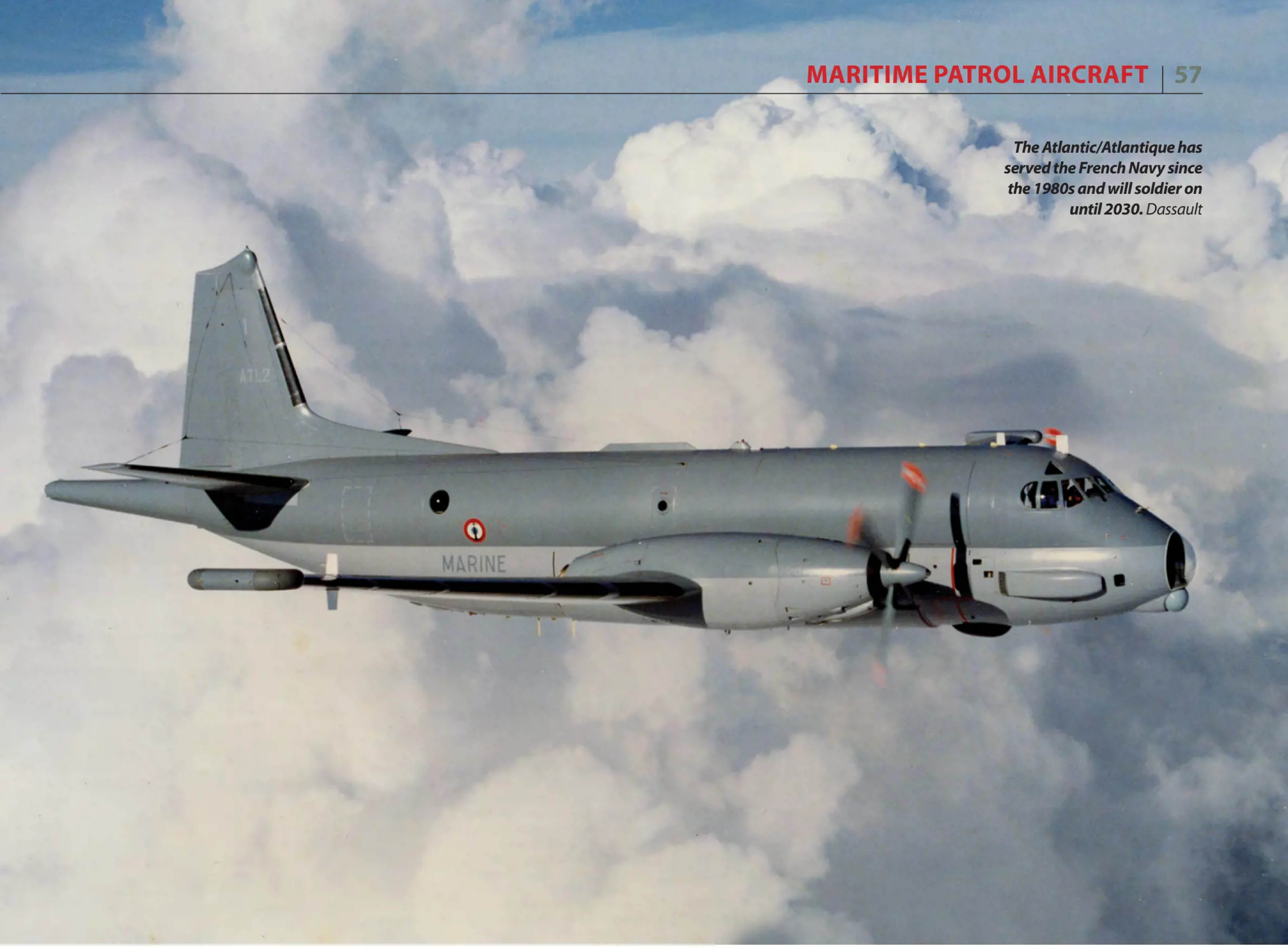
US use and variants of the P-3 would fill a volume by themselves, but as well as the standard patrol aircraft, there were VP-3A staff transports, NP-3B, D and E test aircraft, RP-3D geomagnetic survey aircraft, WP-3D 'Hurricane Hunters', P-3B AEW platforms for US Customs and the EP-3E Aires Elint aircraft. One of the latter was involved in a collision with a Chinese fighter in April 2001 and forced to land on Hainan Island

In recent years the P-3 was increasingly tasked with overland roles and USN P-3Cs were seen with the Raytheon APS-154 Littoral Surveillance Radar System pod, which gave a wide-area overland capability similar to that of the USAF's E-8 JSTARS.

As of 2025 the P-3 had been replaced in the fleet squadrons by the P-8, but remained in use by VP-30 and VX-1, and. VQ-1 with the EP-3E Airies II was due to disband in March 2025.

Lockheed P-3C Orion

Crew:	61,491lb (27,892kg)
Length:	116ft 10in (35.61m)
Wingspan:	99ft 8in (30.37m)
Height:	33ft 9in (10.27m)
Empty weight:	61,491lb (27,890kg)
Max T/O weight:	135,000lb (61,235kg)
Powerplants:	Four Allison T56-A-14 turboprops rated at 4,910hp (3,661kW)
Max speed:	473mph (761km/h)
Service ceiling:	28,300ft (8,625m)
Operational radius with three hours on station:	1,550 miles (2,494km)
Armament:	'Up to 20,000lb (9,072kg) of stores including torpedoes, mines, conventional and nuclear depth bombs, Harpoon, Bullpup and Sidewinder missiles



The Atlantic/Atlantique has served the French Navy since the 1980s and will soldier on until 2030. *Dassault*

Breguet (Dassault) Atlantic

Purpose-Built Patroller

The Atlantic/Atlantique was an early example of international aerospace cooperation and one of very few long-range MPAs not derived from a civil airliner.

It arose from a December 1956 meeting of the NATO Council, which agreed the need for a long-range maritime reconnaissance and anti-submarine aircraft. This would replace the P2V Neptune in French and Dutch service and give West Germany its first post-war MPA. To meet this requirement, industry submitted 31 different proposals

From these the Breguet Br 1150 was selected in January 1959. Breguet Aviation, based at Toulouse, was the lead contractor, with companies in the Netherlands, West Germany and Belgium contributing as part of the SECBAT (*Société Européenne de Construction de l'Avion Breguet Atlantic)* consortium, founded in October 1961. This was a precursor to the industrial groupings that would produce the Jaguar, Tornado and Typhoon combat aircraft. The first of four Atlantic prototypes flew at Toulouse on 31 October 1961.

The Atlantic was powered by two Rolls-Royce Tyne turboprops built under license by SNECMA of France. It was of conventional low-wing appearance, the most notable characteristic being a 'double-bubble' fuselage. The upper section was the pressurised cabin and the lower half contained the weapons bay and sonobuoy launchers. There was a clear observer's window in the nose and two in the rear fuselage. A retractable radome under the forward fuselage housed search radar and there was a MAD boom in the tail. At the top of the tail fin was a fairing for an electronic support measures (ESM) system.

Initial production orders were for 20 for France and 20 for the Federal Republic of Germany. France ordered a further 20 and the last of the first production run was delivered to the *Aéronavale* at the end of 1968. At the same time the line was closing down the Netherlands decided to buy nine, the first four of which were supplied by France. Italy ordered 18 and Aeritalia and Alfa-Romeo joined the consortium. An additional four were ordered by France to replace the Dutch aircraft. Production of the Atlantic 1 amounted to 89 aircraft. Breguet merged with Dassault in 1971, to become Dassault-Breguet, and later just Dassault. Production of the second series began in 1972. The Dutch aircraft were designated SP-13A and operated by 321 Squadron of the Dutch Navy (*Marineluchtvaartdienst*/MLD) at Valkenburg.

Italian Atlantic MM40115 of 41 Stormo lands at an air show in the UK. *David Willis*

Between 1973 and 1981, three were lost, all at sea. The worst accident was that to 255, which ditched off the Inner Hebrides while shadowing the Soviet cruiser *Kiev* with three of the 12 crew killed. MLD service was relatively brief, the Atlantics being replaced by P-3C Orions in 1981. In 1976, the French Navy sold three of its aircraft to Pakistan, followed by another in 1986. They were upgraded with Thomson CSF Ocean Master radar and the ability to carry the Exocet missile. One was shot down by MiG-21s in August 1999 when it violated Indian airspace. The German Naval Air Force (*Marineflieger*) stationed its Atlantics with MFG 3 at Nordholz. Five of the aircraft were configured for signals intelligence (SigInt) missions. Externally they retained the MAD boom and ESM 'football', but gained an antenna dome on the underside and wingtip pods. They performed many missions along the Iron Curtain and during the wars in the Balkans in the 1990s.

Many studies to replace the Atlantic I culminated in a 1978 decision to build an updated version as the 'minimum change' Atlantic *Nouvelle Generation,* which became the Atlantique 2 or ATL2. The first of two prototypes converted from Atlantics flew

Germany has replaced its Atlantics with ex-Dutch P-3 Orions. 61+14, seen at RAF Fairford, is now preserved at Nordholz. *David Willis*

An Atlantique 2 rests between missions on Operation Chammal, the French contribution to the US-led Operation Inherent Resolve, the fight against ISIS in Iraq and Syria.

on 8 May 1981. The only order came from the Aéronavale, initially for 42 aircraft, later reduced to 28. Deliveries took place from 1984 to 1989. They were built by the SECBAT consortium, now comprising Dassault, Aerospatiale, Dornier, MBB, Aeritalia, and Sabca/Sonaca/FN.

There were few major changes to the airframe except strengthening and better corrosion protection. The Tyne engines were retained, but new composite propellers were fitted and fuel capacity was increased. Internally, the avionics were modernised including a new tactical computer, Thomson-CSF Iguane radar and a FLIR turret. The ESM football was replaced by wingtip antennas. The ability to launch AM39 Exocet missiles was added.

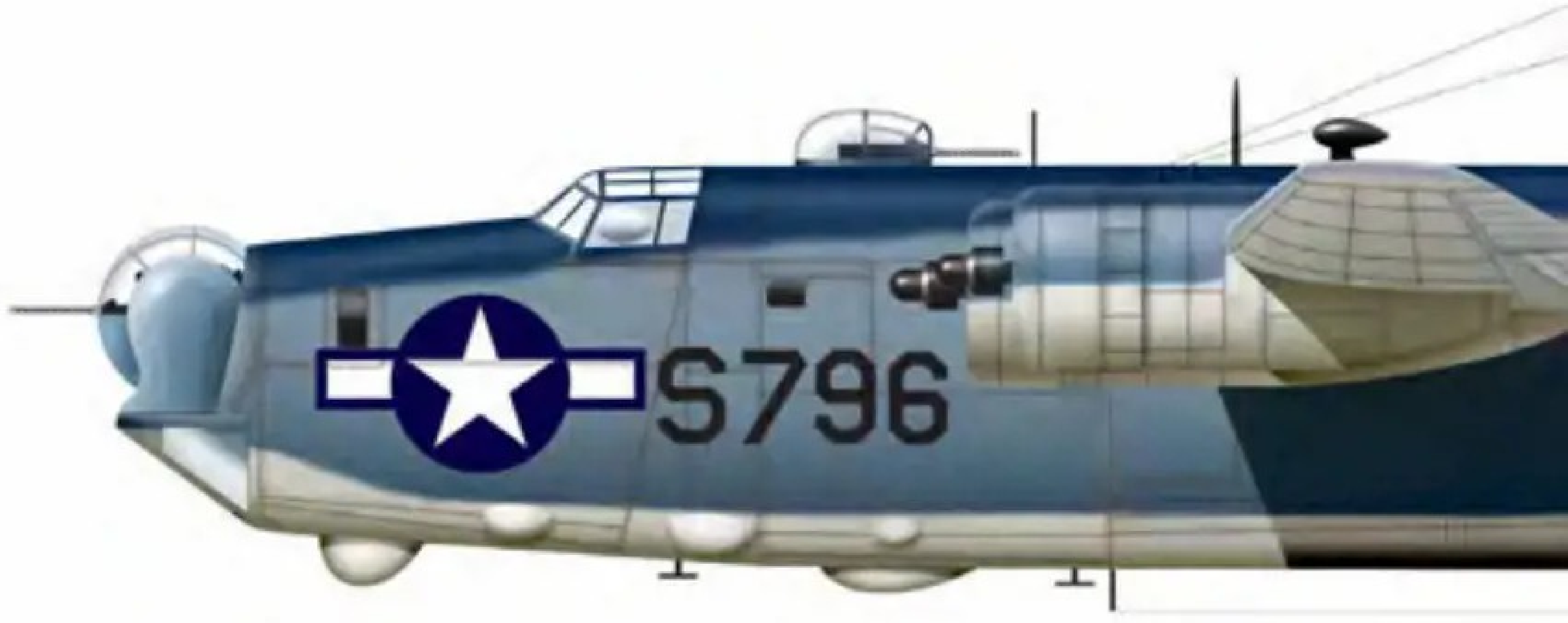
From 2013, ATL2s were deployed to Africa and Iraq to serve in a tactical support role, performing intelligence, surveillance and reconnaissance (ISR) missions against Islamist insurgent groups, and on occasions even dropping laser-guided bombs.

Today 18 ATL2s remain in active service, although they are reportedly due to be replaced by an MPA based on the Airbus A321 by 2030. To carry them through to that date an upgrade to 'Standard 6' configuration has been underway. This introduces Thales Search Master radar with active antenna, new Thales acoustic subsystem to gather and process signals from the latest-generation sonobuoys, a new WESCAM optronic ball and new interior consoles. A proposed Atlantic/Atlantique 3 was offered for export including as a Nimrod replacement for the RAF, but was never built.

The most recent development is the Standard 6 upgrade, designed to keep France's Atlantique 2s in service until the end of the decade. Dassaul

Atlantique 2

Crew:	12
Length:	103ft 9in (31.62m)
Wingspan:	122ft 9in (37.42m)
Height:	35ft 9in (10.89m)
Empty weight:	56,437lb (25,600kg)
Max T/O weight:	101,852lb (46,200kg)
Powerplants:	Two Rolls-Royce Tyne RTy.20 Mk.21 turboprops, each rated at 6,100hp (4,549kW)
Max speed:	402mph (648km/h)
Service ceiling:	30,000ft (9,145m)
Range:	(ferry) 5,638 miles (9,075km); endurance up to 18hrs
Armament:	Exocet ASMs, laser-guided bombs, MU90 torpedoes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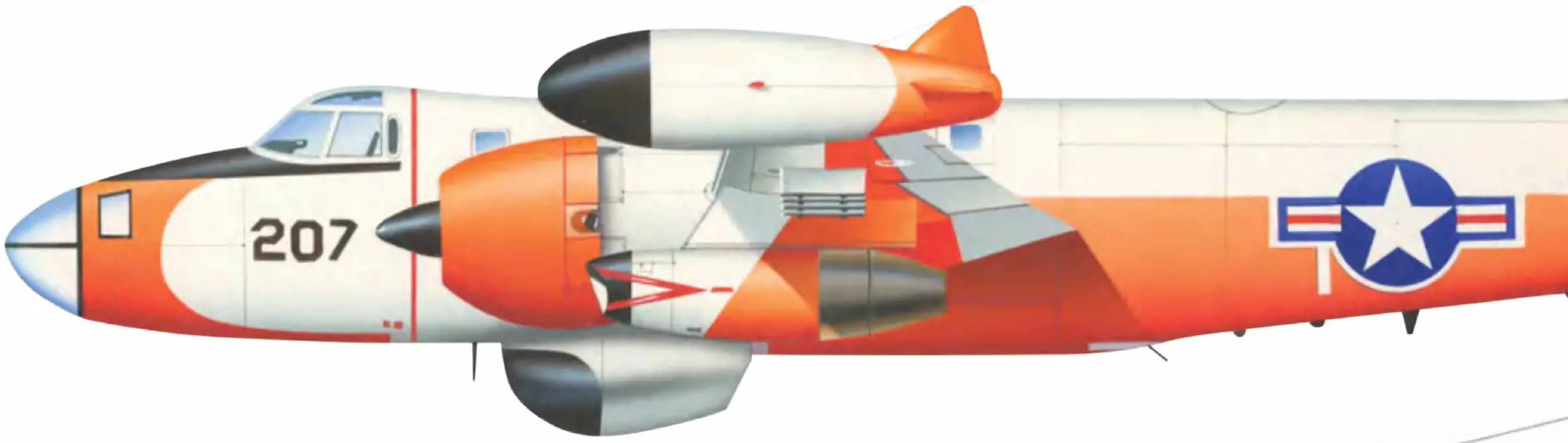
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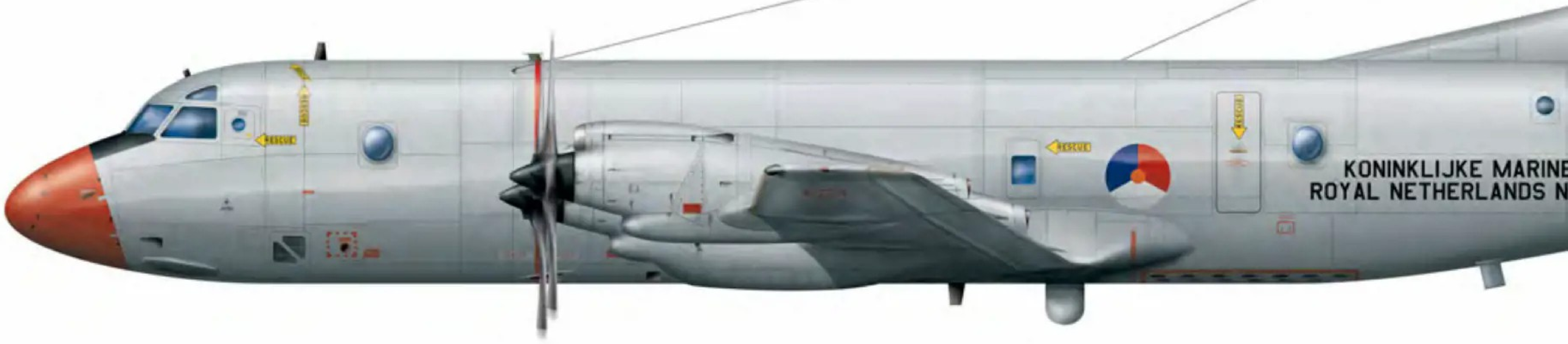
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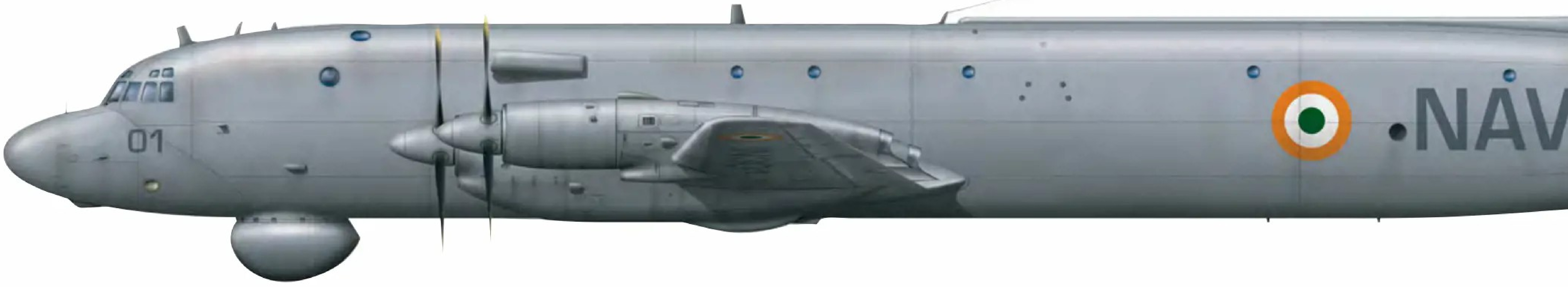
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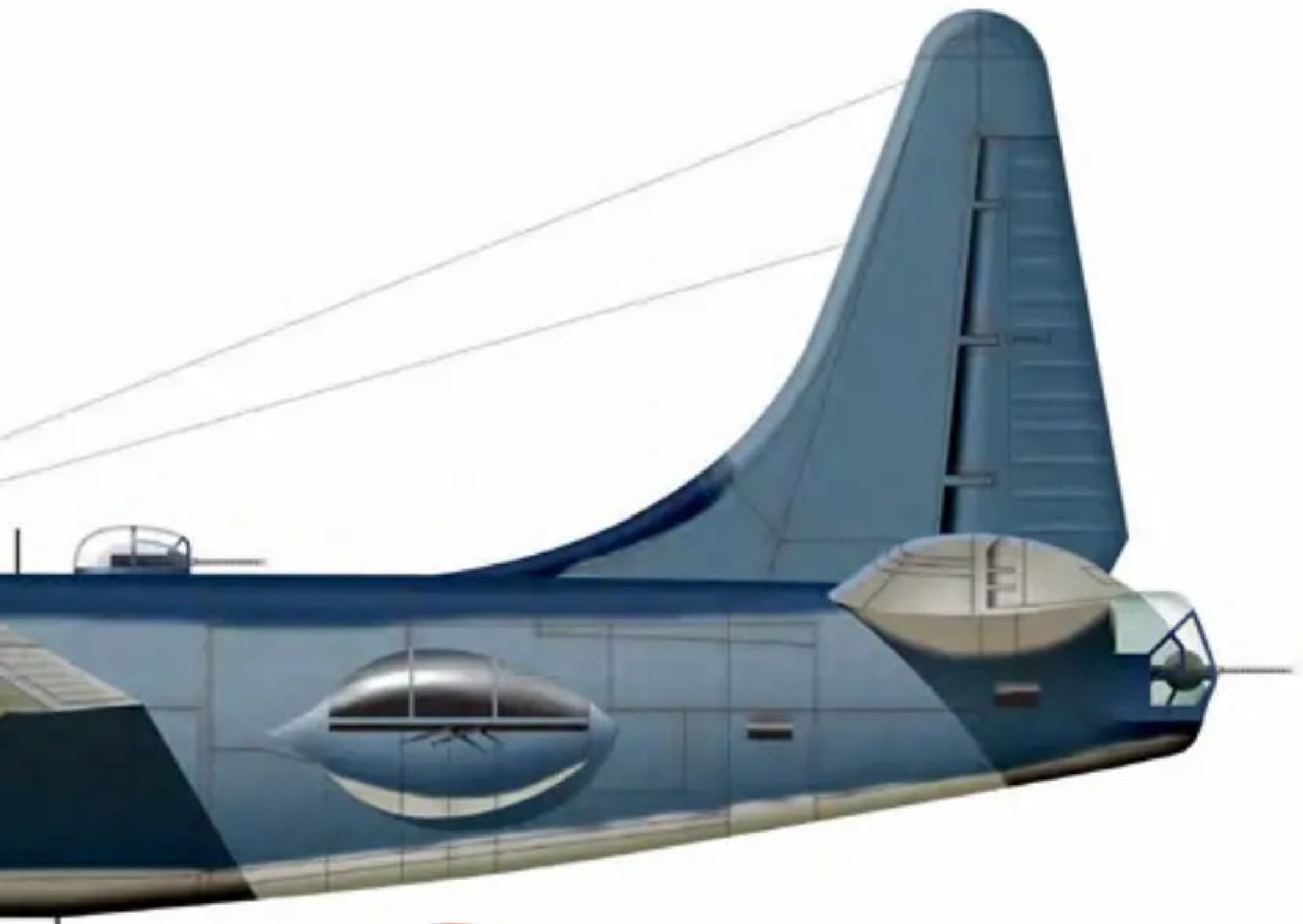
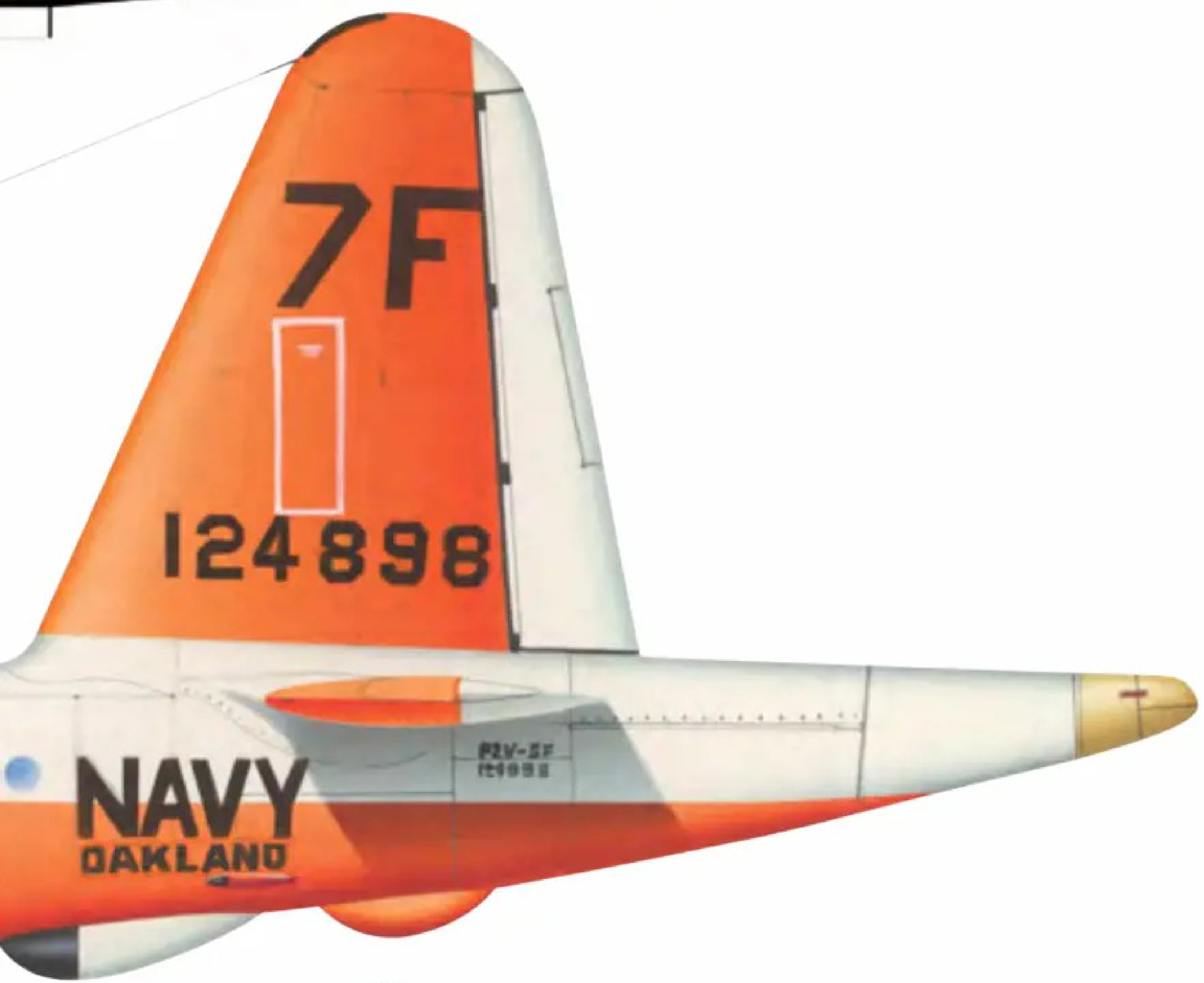


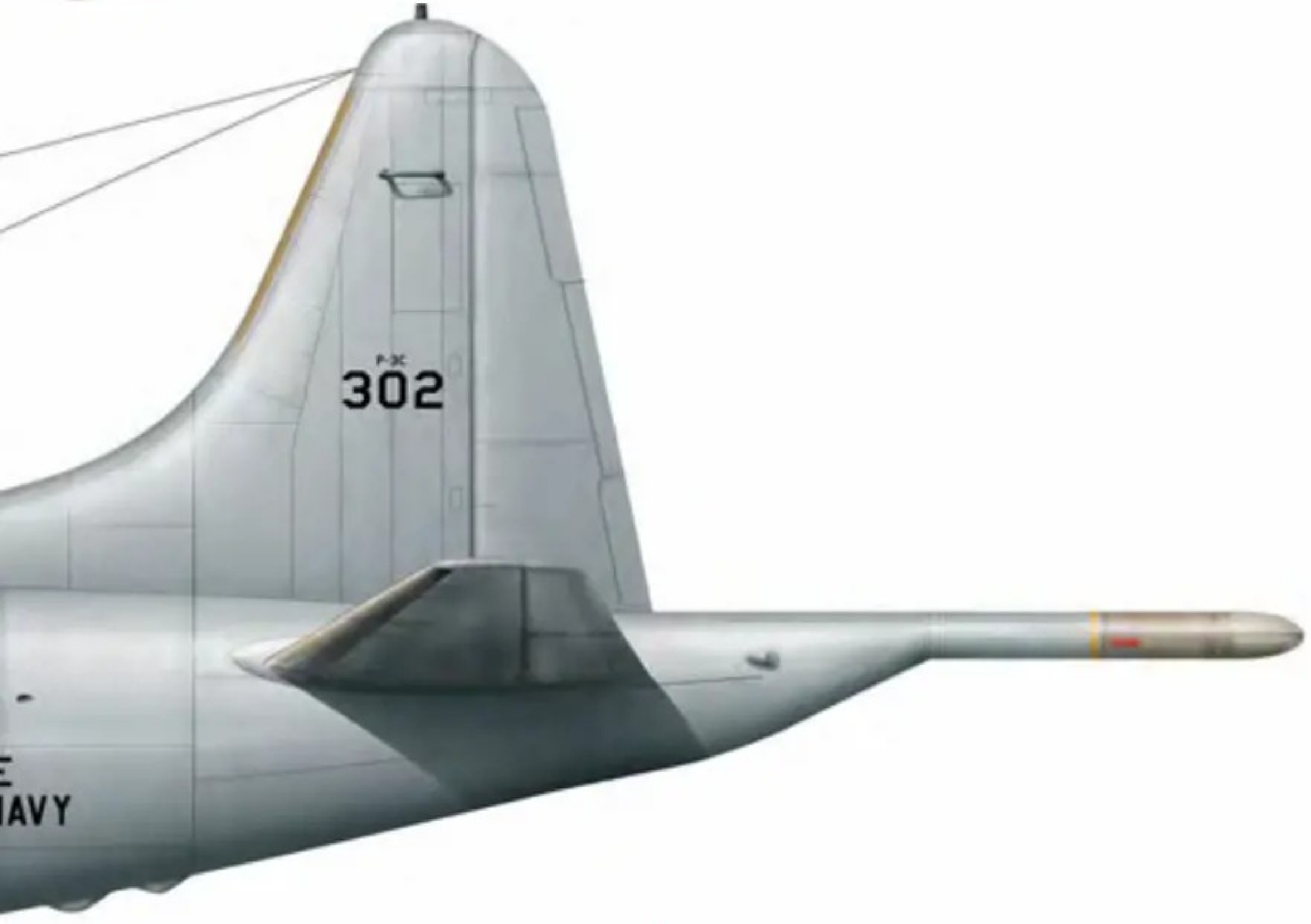
Consolidated PB4Y-2 Privateer
Bu. No. unknown
VPB-108, FAW-1
Naha, Okinawa, 1946

This Privateer wears no visible Bureau Number, but its code matches the 'last three' of PB4Y-2 59796, which was delivered to VPB-197 on 11 May 1945. In a short time period it was transferred to VPB-200, VPB-118, VPB-124 and then to VPB-108 in December 1945, serving with them at Naha, Okinawa until October 1946. It spent most of 1946 in the care of several headquarters and fleet service squadrons, before joining the Privateer pool at NAS Corpus Christi, Texas. Its last assignment was with the Tactical Test Squadron at NAS Patxuent River, Maryland and it was finally stricken at the Naval Ordnance Test Squadron at Chincoteague, Virginia.



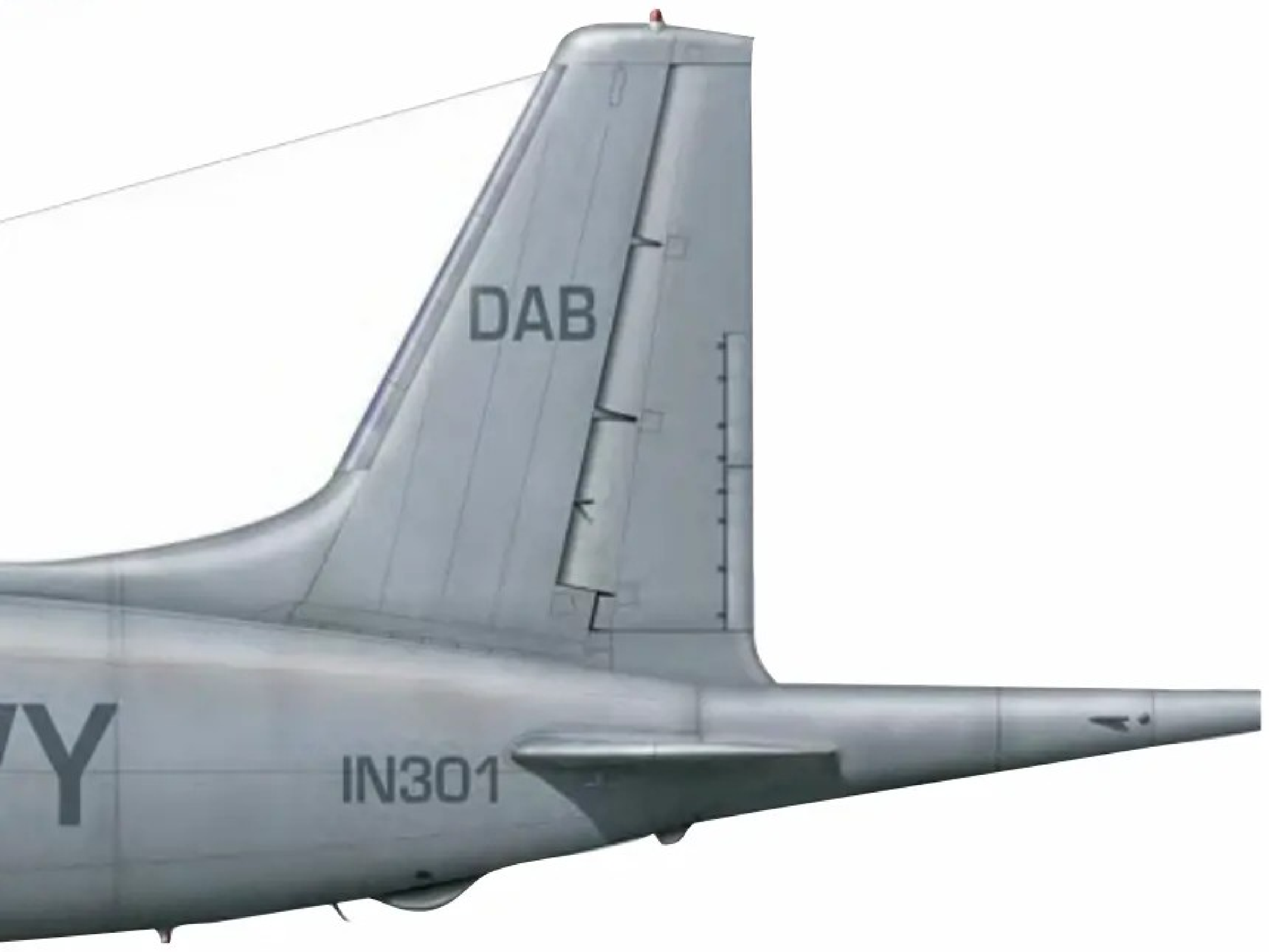
Lockheed P2V-5F (P-2E) Neptune
Bu. No. 124898
US Naval Air Reserve
NAS Oakland, California, 1959

Delivered as a P2V-5, the full history of this Neptune is not known, but in August 1952 it was flying with VP-812 from NAS Whidbey Island and was involved in some kind of mishap off the coast of Washington State. It was noted with VP-29 at Atsugi, Japan in March 1953, where the crew were reportedly involved in a UFO encounter while on a routine ASW patrol. One of 360 Neptunes converted to P2V-5Fs with the Westinghouse jet pods, it later became one of 11 P2V-5FEs with additional avionics. This variant was redesignated EP-2E in 1962. It was with Oakland's Naval Air Reserve Unit, which flew the Neptune from June 1957 to June 1961. Bu.No. 124898 was struck off charge at Tuscon on 20 April 1968 and stored at MASDC.



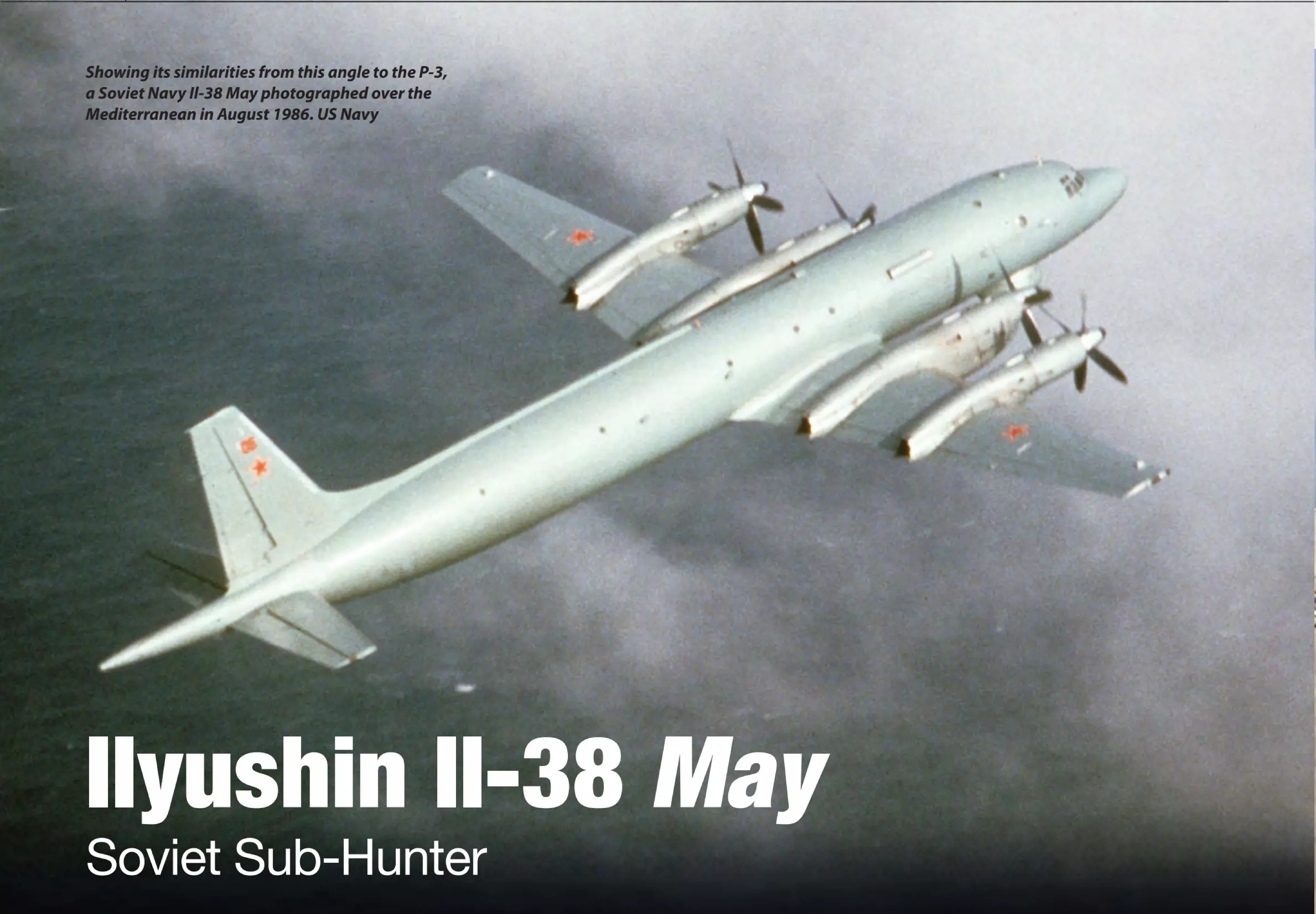
Lockheed P-3C CUP Orion
301, C/N 285E-5741
320 Squadron, Koninklijke Marine
Valkenburg, the Netherlands, 2006

Allocated US Navy Bureau No 161370, this Orion was delivered to the Royal Netherlands Navy's paritime patrol force (MARPAT) as '302' in April 1982, being equipped to P-3C-II 1/2 standard. Based at Valkenburg, but occasionally detached to the Netherlands Antilles It was one of ten that went through the Capability Upkeep Program (CUP) from 1999, but eight of which were then sold to Germany when the Dutch announced the disbandment of their P-3 fleet in 2006. It was then operated by Marinefliegergeschwader 3 (MFG3), based at Nordholz. As 60+02. Scheduled to be the prototype for an avionics upgrade and allocated to test unit WTD-61, it was last noted dismantled at Manching.



Ilyushin Il-38 May IN301
C/N 81011007
INAS 315,
Indian Navy
Dabolim Air Station,
Goa, India

The first of seven Il-38s for the Indian Navy, IN301 was built in 1970 and operated by the Soviet Navy (AVMF) until transferred to India in 1977 along with two others. Another pair arrived in 1983, and two more in 2008, these latter aircraft replacing two lost in a collision. IN301 was upgraded in Russia to Il-38SD standard with the Sea Dragon avionic suite in the 2003-2006 timeframe and later received further modifications including IAI-Elta surface search radar. The Il-38 fleet was retired on 31 October 2023, by which time IN 301 had already been preserved at Dabolim.



Showing its similarities from this angle to the P-3, a Soviet Navy Il-38 May photographed over the Mediterranean in August 1986. US Navy

Ilyushin Il-38 *May*

Soviet Sub-Hunter

Analogous to the P-3 Orion, the Il-38 has served the USSR and Russia even longer with no replacement in sight.

The Il-38 was based on the Ilyushin Il-18D airliner, a Russian equivalent to the Bristol Britannia. There were several military derivatives of the Il-18 including the Il-18V and Il-22M airborne command posts and the Il-20M Coot-A Elint aircraft.

From the outset, the Il-18 airliner, which first flew in June 1957, was the preferred platform for what became the Il-38. Its transformation into a patrol aircraft resulted from operational requirements formed in 1960 for a long-range ASW aircraft for the Aviatsiya Voyenno-Morskogo Flota (AV-MF) or naval air fleet. The fuselage outline, wings, tail, engines and undercarriage were largely the same as the airliner's. Windows and doors were deleted, an additional fuel tank was added in the wing centre-section

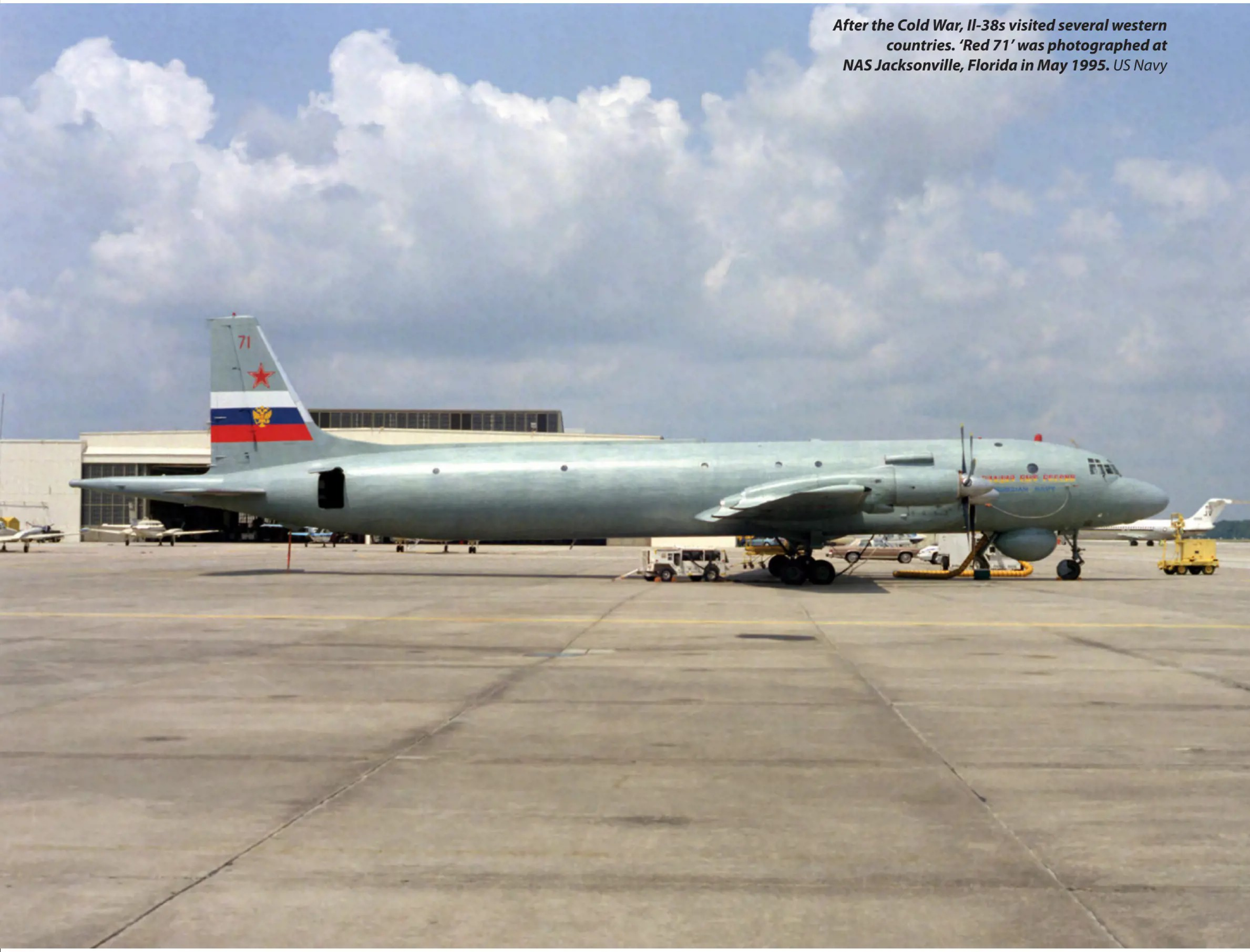
The cabin was divided into pressurised and unpressurised sections, separated by weapons bays forward and aft of the wing. The wing position was moved forward by 3m (9ft 10in), which improved handling, but generated excessive noise inside the cabin.

A hemispherical radar dome contained Berkut (golden eagle) search radar was installed under the nose. At first this caused airframe vibration, which was cured by tapering it at the rear. A MAD boom was fitted at the tail. A teardrop-shaped rescue capsule could be carried under the forward weapons bay and dropped to sailors or airmen in distress.

The prototype flew on 28 September 1961 at Zhukovsky. The mission system included the first digital computer installed in a Russian aircraft and problems with this caused many delays to the state acceptance trials. The first production aircraft flew in September 1967, and although 250 had been planned at one time, only 58 Il-38s (or 65, according to some sources) were completed by February 1972. A long test programme saw the Il-38 enter the AV-MF inventory in January 1969, after more than

Ilyushin Il-38 *May*

Crew:	Seven
Length:	131ft 7in (40.1m)
Wingspan:	122ft 9in (37.4m)
Height:	33ft 1in (10.1m)
Empty weight:	n/k
Max T/O weight:	145,500lb (66,000kg)
Powerplants:	Four Ivchencko AI-20M turboprops, each rated at 4,250hp (3,171kW)
Max speed:	404mph (650km/h)
Service ceiling:	32,810ft (10,000m)
Range:	5,135 miles (9,500km); endurance 12hrs
Armament:	Payload of 8,000kg (17,640lb) including ASW torpedoes, mines, nuclear and conventional depth charges and sonobuoys; Kh35 (Russia) or Sea Eagle (India) ASMs.



After the Cold War, Il-38s visited several western countries. 'Red 71' was photographed at NAS Jacksonville, Florida in May 1995. *US Navy*

seven years of trials. In 1970 it was noticed by the west and given the NATO reporting name *May*. There were few variants, but the Il-38M was fitted with a fixed refuelling probe, and the Il-38MZ could carry a buddy refuelling package.

As well as patrolling the coastal waters of the USSR, the Kremlin deployed the Il-38s to friendly states around the Middle East, including Egypt, Yemen and Ethiopia, mainly to track US carrier battlegroups transiting the Red Sea. Two Il-38s were destroyed on the ground at Asmara by Eritrean forces during the country's civil war.

After the dissolution of the Soviet Union Aircraft left to Ukraine were scrapped. There was no money for a new patrol aircraft, so the Il-38 was modernised, although the airframe and basic systems remained the same. The Il-38N was fitted with a new radar and sonobuoy receiver/processor, and most notably a new ESM system mounted in a somewhat ungainly angular pod above the forward fuselage. This complex was called Sea Dragon, and the aircraft was redesignated Il-38SD. It is able to launch the Kh-35 (AS-20 *Kayak)* air-to-surface missile and an estimated 21 Il-38s remained in AVMF service in 2024.

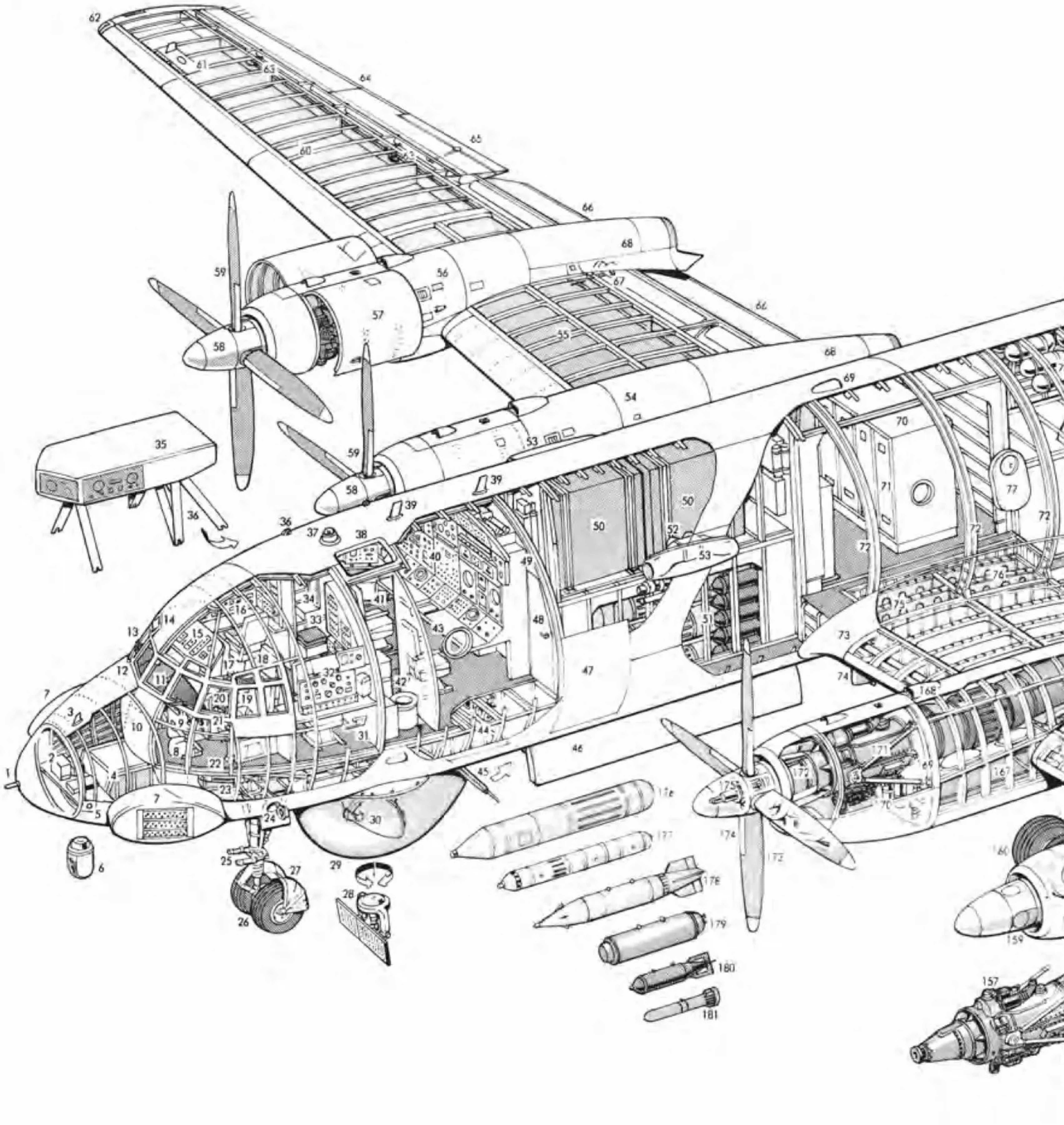
The only export customer was India, which received a total of seven aircraft. Three were supplied in 1977 and two in 1983 from Soviet Navy stocks and served with INAS 315 'Winged Stallions' at INS Hansa at Dabolim in Goa. They were upgraded in 1999 with upgraded mission systems and a new ESM suite, which resulted in new fairings on the sides of the nose and at the root of the tailboom. Unfortunately, in October 2002, during a flypast to mark the Indian Naval Air Service's silver jubilee, as well as 30,000 hours of accident-free flying, two Il-38s collided and crashed near Dabolim, killing 12 aircrew and three people on the ground. In 2008 a replacement pair was delivered.

Upgraded to Il-38SD standard from 2003, the Indian *May*s were integrated with the BAe Sea Eagle anti-ship missile and the Russian radar was replaced by an IAI-Elta surface search radar in 2015. A later addition was the *Sarvadhari* communications intelligence (Comint) suite. An Indian innovation was a supply canister that could be dropped to ships at sea. Two versions, one 110lb (50kg) and another 300lb (136kg) were fielded.

By the time the Indian Mays retired in October 2023, they had racked up more than 52,000 operational flying hours over 46 years.

Ilyushin Il-38 *May*

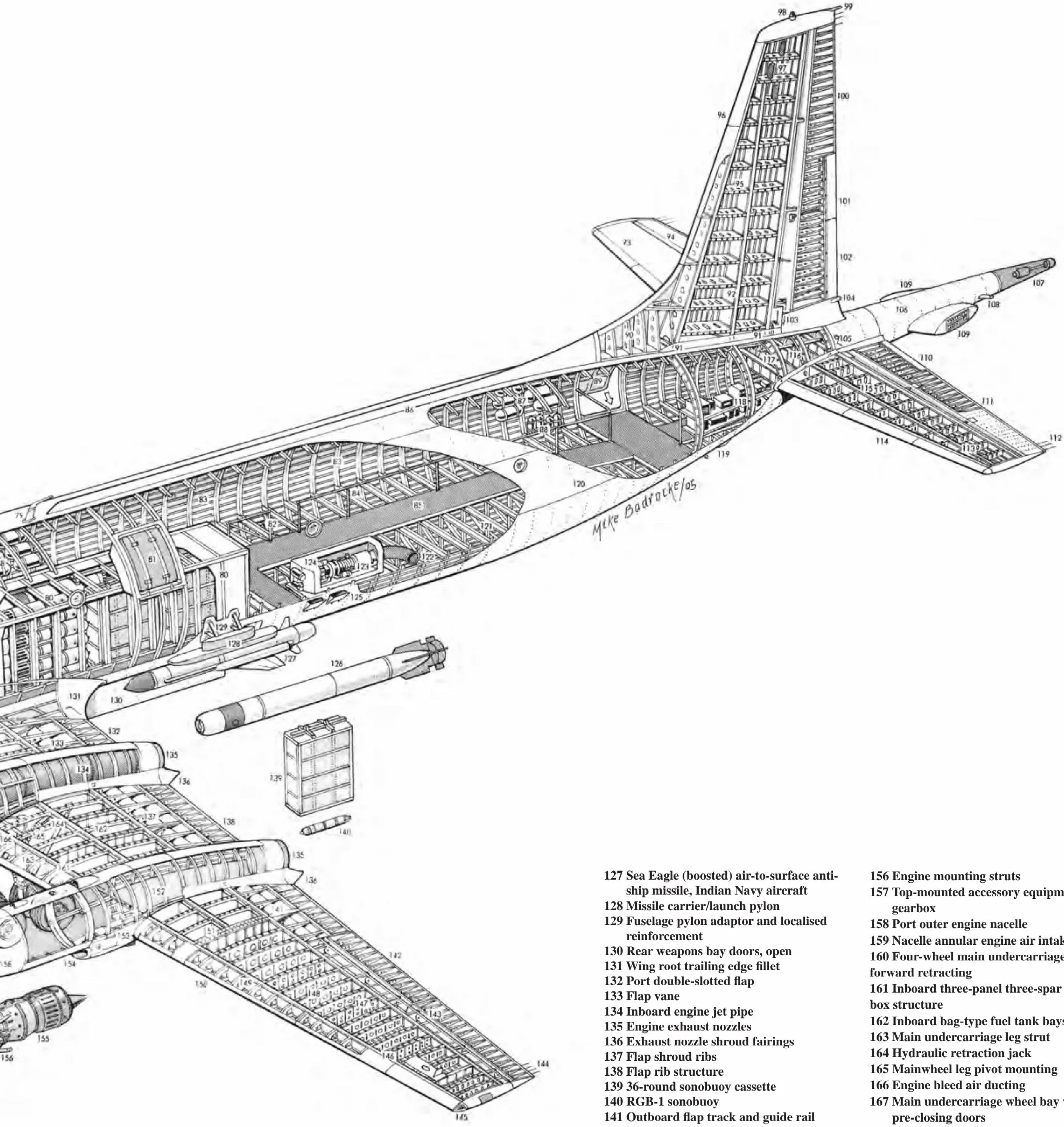
1 ILS antenna
2 Forward equipment shelf
3 IFF antenna
4 Nose undercarriage wheel bay
5 Forward oblique radar warning antenna
6 SD5 electro-optical system turret, Il-38SD aircraft
7 Chaff/flare launchers, port and starboard, Indian aircraft
8 Rudder pedals
9 Instrument panel
10 Forward pressure dome
11 Instrument panel shroud
12 Windscreen wipers
13 Electrically heated windscreen panels
14 Cockpit eyebrow windows
15 Overhead switch panel
16 Communicatons systems officer’s station
17 Co-pilot’s seat
18 Flight engineer’s sliding seat
19 Command pilot’s seat
20 Control column hand wheel
21 Direct vision sliding side window panel
22 Cockpit floor level
23 Nosewheel hydraulic retraction jack
24 Retractable landing light
25 Nosewheel hydraulic steering jacks
26 Twin nosewheels, forward-retracting
27 Nosewheel spray guards
28 Leninets 2SD1 radar scanner, Il-38SD aircraft
29 Ventral radome
30 Berkut search/navigation/weather radar scanner
31 Pitot head, port and starboard
32 Navigator’s station
33 Step to astro-navigation viewer
34 Buffet unit
35 2SD9 ESM equipment housing, cabin roof-mounted
36 ESM housing support struts and mountings
37 Astro-navigation viewer
38 cockpit roof escape hatch
39 Dual HF communications antennas
40 Aft workstation controls and displays, replaced by ‘Sea Dragon’ equipment with MFD screens in Il-38SD Tactical Commander’s station
41 Tactical Commander’s station
42 Toilet compartment
43 Sensor Systems Operator’s station, radar, acoustic and MAD
44 Underfloor sloping entry/escape chute
45 Entry/escape hatch, open
46 Forward weapons bay doors, open
47 Fuselage skin doubler/propeller debris shield
48 Cabin door to unpressurised main fuselage, openable in flight after crew cabin depressurisation
49 Crew cabin rear pressure bulkhead
50 Fuselage fuel tanks (2), total system capacity 9,305 US gal. (33,820 litres)
51 Forward weapons bay
52 Air conditioning packs, port and starboard
53 Heat exchanger intake/exhaust ducts
54 Starboard inboard engine nacelle
55 Inboard wing panel bag-type fuel tankage
56 Outboard engine nacelle
57 Hinged cowling panels
58 Propeller spinners
59 AV-68I four-bladed, constant-speed reversible propellers
60 Outer wing panel, integral fuel tankage
61 Overwing fuel filler, pressure filler in inboard nacelle
62 Starboard navigation light
63 Aileron hinge control linkage, manual operation
64 Starboard two-segment aileron



65 Aileron trim tab
66 Starboard double-slotted flap, extended
67 Flap screw jack, two-per-flap, torque shaft-driven from central twin electric motors
68 Nacelle jet pipe fairings
69 Equipment bay cooling air outlet
70 Main electronic equipment compartment
71 TsVM-264 Plamya computer racks
72 Wing spar attachment point fuselage main main frames
73 Wing root leading-edge fairing
74 Ventral light stores pylon, Il-38SD aircraft
75 Wing centre section carry-through structure

76 Centre wing box integral fuel tank
77 Centre fuselage escape hatch, port side only
78 Oxygen bottles (12)
79 Communications antenna
80 Rear weapons bay
81 Life raft stowage
82 Flight recording equipment
83 Fuselage frame and stringer structure
84 Handrail
85 Aft fuselage central walkway
86 Fin root extended glassfibre strake/HF antenna
87 Oxygen bottles (7)
88 Nitrogen bottles (4), fuel system pressurisation

89 Aft fuselage service door, open
90 Fin root fillet structure
91 Fin spar bolted attachment joints
92 Three-spar fin torsion box structure
93 Starboard tailplane
94 Starboard elevator
95 Fin rib structure
96 Fin leading edge, electrically de-iced
97 RSBN-25 Svod radio navigation antenna
98 Anti-collision beacon
99 Aft ILS antenna
100 Rudder rib structure
101 Rudder trim tab
102 Spring tab
103 Rudder hinge control, manually operated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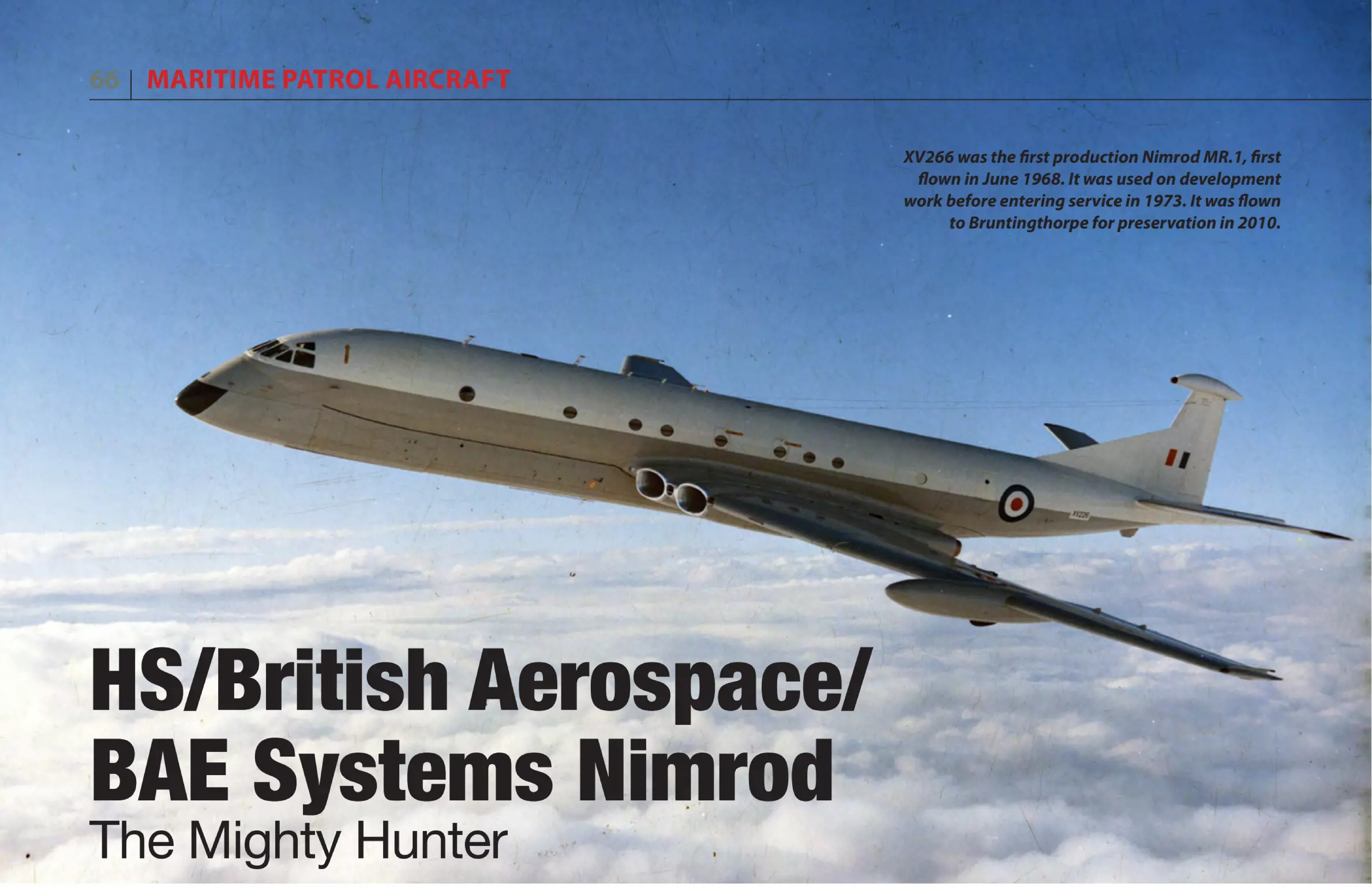
104 Tail navigation light
105 Elevator hinge control
106 Extended tail boom
107 Magnetic Anomaly Detector (MAD) housing
108 Aft oblique radar warning receiver
109 Rear chaff/flare dispenser
110 Elevator trim tab
111 Port elevator rib structure
112 Static dischargers
113 Three-spar tailplane torsion box structure
114 Leading-edge electrical de-icing
115 Tailplane rib structure
116 Tailplane centre section
117 Fin and tailplane mounting main frame
118 Rear equipment rack
119 Tail bumper
120 Fuselage skin panelling
121 Floor beam structure
122 APU exhaust
123 TG-16M Auxiliary Power Unit (APU)
124 APU fireproof housing
125 APU hinged intake doors
126 AT-2 torpedoes (2), maximum ordnance load 18,520lb (8,400kg)
127 Sea Eagle (boosted) air-to-surface anti-ship missile, Indian Navy aircraft
128 Missile carrier/launch pylon
129 Fuselage pylon adaptor and localised reinforcement
130 Rear weapons bay doors, open
131 Wing root trailing edge fillet
132 Port double-slotted flap
133 Flap vane
134 Inboard engine jet pipe
135 Engine exhaust nozzles
136 Exhaust nozzle shroud fairings
137 Flap shroud ribs
138 Flap rib structure
139 36-round sonobuoy cassette
140 RGB-1 sonobuoy
141 Outboard flap track and guide rail
142 Port two-segment aileron
143 Aileron rib structure
144 Static dischargers
145 Port navigation light
146 Outer wing panel integral fuel tank
147 Wing rib structure
148 Outer wing panel integral fuel tank
149 Leading edge rib structure
150 Leading edge electrical de-icing
151 Outer wing panel bolted attachment joint
152 Ventilated jet pipe heat shield
153 Ventral oil cooler
154 Oil cooler air intake
155 Progress/Ivchenko AI-20M turboprop engine
156 Engine mounting struts
157 Top-mounted accessory equipment gearbox
158 Port outer engine nacelle
159 Nacelle annular engine air intake
160 Four-wheel main undercarriage bogie, forward retracting
161 Inboard three-panel three-spar torsion box structure
162 Inboard bag-type fuel tank bays
163 Main undercarriage leg strut
164 Hydraulic retraction jack
165 Mainwheel leg pivot mounting
166 Engine bleed air ducting
167 Main undercarriage wheel bay with pre-closing doors
168 Jet pipe cooling ram air intake
169 Engine mounting bulkhead/firewall
170 Fire extinguisher bottles
171 Port inboard engine installation
172 Integral propeller reduction gearbox
173 Port inboard four-bladed propeller
174 Blade root electrical de-icing boot
175 Propeller hub pitch change mechanism
176 RGB-3 sonobuoy
177 RGB-2 sonobuoy
178 KAB-500PL 500kg HE depth bomb
179 UDM-500 500kg mine
180 PLAB-250-120 120kg HE bomb
181 GB-1000 100kg HE bomb



XV266 was the first production Nimrod MR.1, first flown in June 1968. It was used on development work before entering service in 1973. It was flown to Bruntingthorpe for preservation in 2010.

HS/British Aerospace/ BAE Systems Nimrod

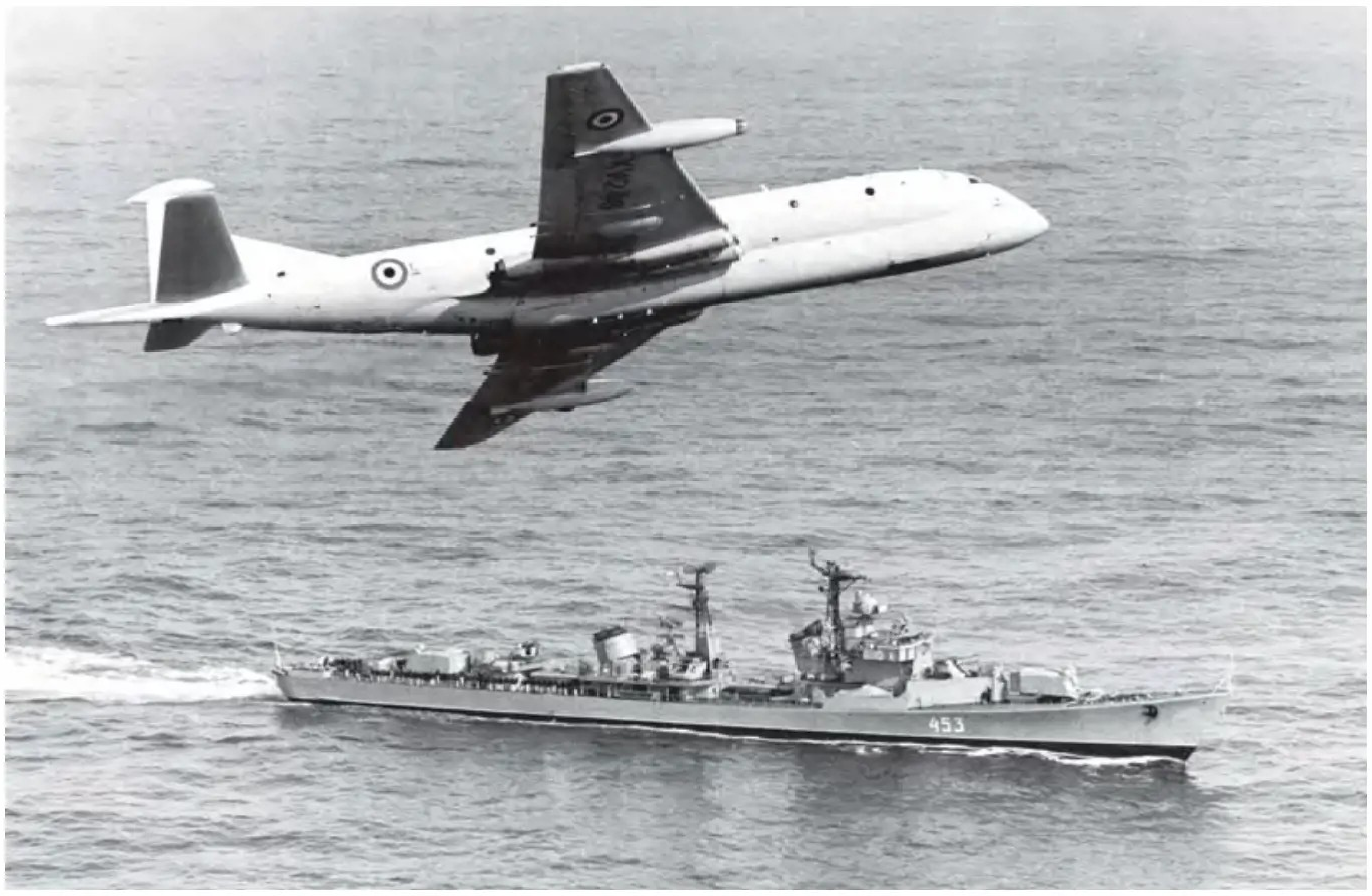
The Mighty Hunter

For some years arguably the world's best ASW aircraft, the Nimrod became increasingly outdated. A major upgrade ended in costly failure, leaving Britain with a ten-year 'capability gap'.

Work began on defining a replacement for the RAF's fleet of ageing Shackletons as early as 1958, eventually coalescing in Air Staff Requirement (ASR) 381 in June 1964. Competitors included variants of the BAC-111 and Hawker Siddeley Trident airliners and even a version of the Short Belfast, but in the end Hawker Siddeley were chosen to develop an ASW patrol aircraft from the de Havilland DH.106 Comet 4C airliner. This would be named Nimrod after a mighty hunter of biblical mythology.

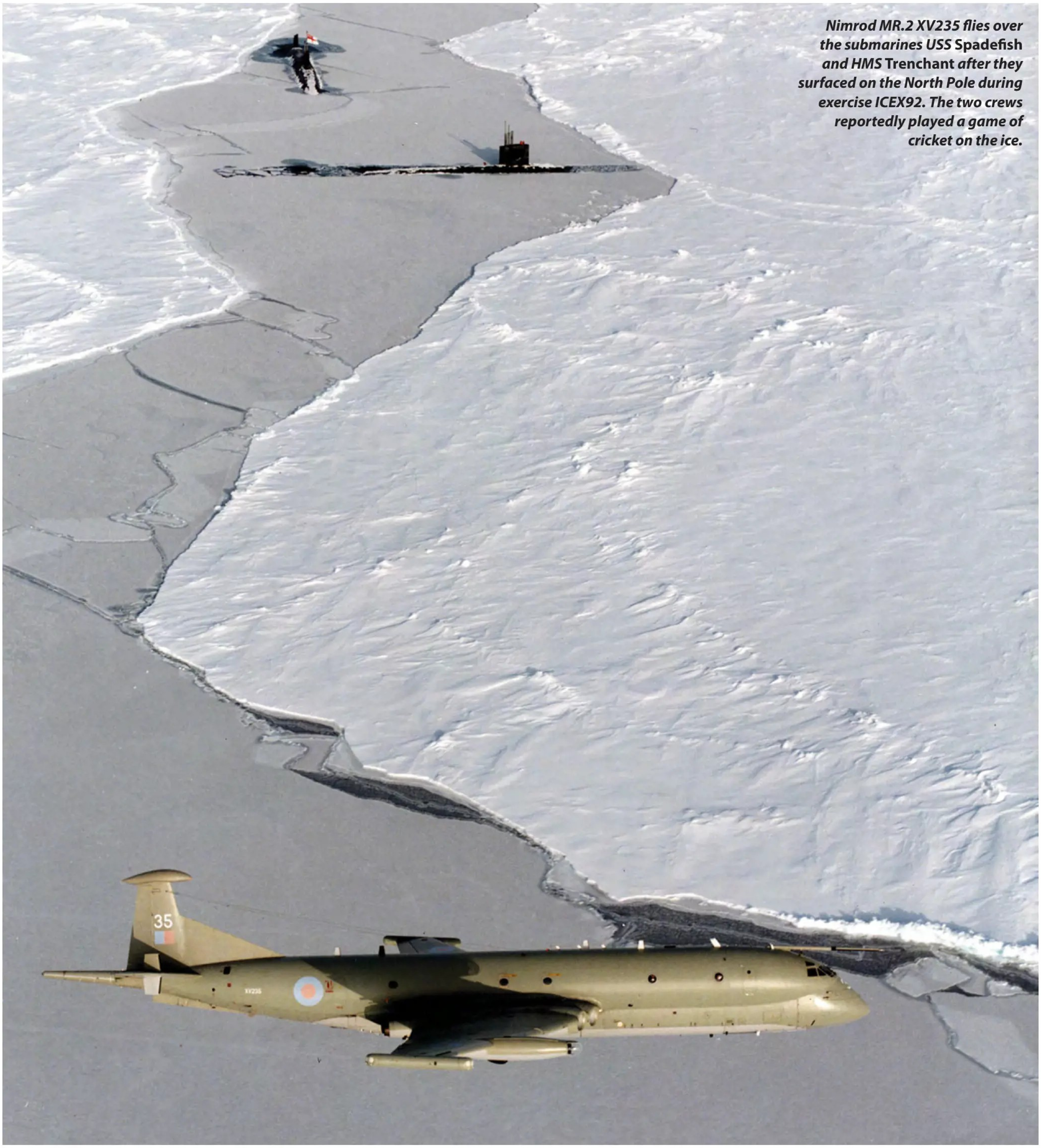
The Comet 1 flew as far back as 1949, becoming the first jet airliner to enter service. This glory was short-lived, however, as a number of crashes, some attributed to structural failure, saw the grounding of the type in commercial service. The similar Comet 2 served successfully with RAF Transport Command, but it was not until the larger, stronger Comet 4 flew in June 1959 that the type's reputation began to recover.

Two unsold Comet 4Cs were converted into HS.801 prototypes. Changes to the external shape included a re-profiled nose for the search radar, a 'football' on the fin tip for ESM equipment and a MAD 'stinger' in the tail. A ventral weapons pannier capable of holding up to nine torpedoes was added beneath the cabin, giving a 'double-bubble' cross-section. A 6ft (2m) section was removed from the fuselage to improve directional stability.



A Nimrod overflies the Kotlin*-class destroyer* Speshny*, which was assigned to the Baltic Fleet circa 1975. Soviet warships frequently changed their pennant numbers to confuse western intelligence.*

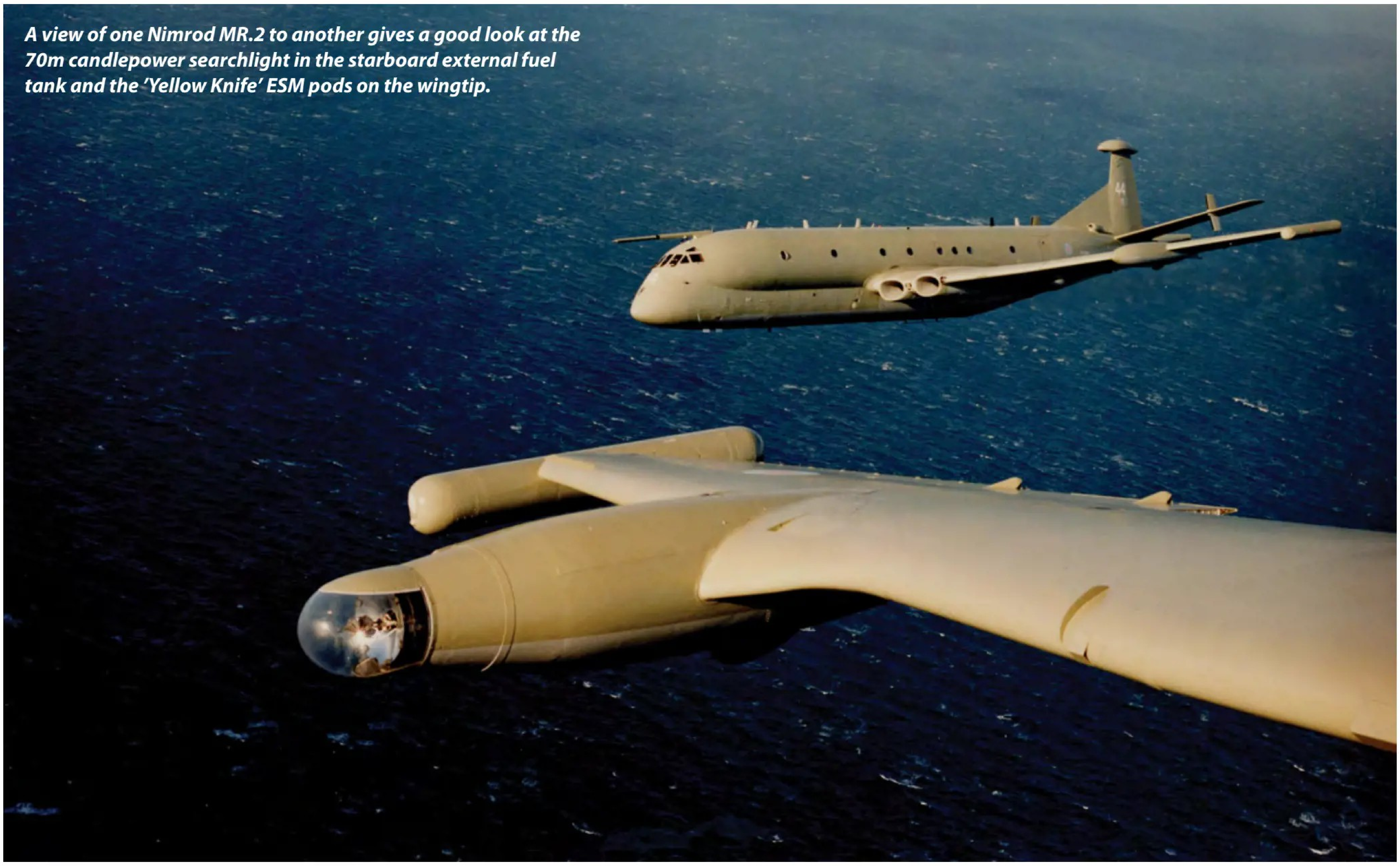
The prototype HS.801, XV148, flew from Chester on 23 May 1967, landing at Woodford, where most Nimrod work would subsequently take place. The Nimrod was powered by four 12,500lb st (55.6kN) Rolls-Royce Spey Mk. 250 non-afterburning turbofans, replacing the 10,500lb st (46.7kN) Avon Mk. 524 turbojets in the Comet 4.



Nimrod MR.2 XV235 flies over the submarines USS* Spadefish *and HMS* Trenchant *after they surfaced on the North Pole during exercise ICEX92. The two crews reportedly played a game of cricket on the ice.

The first of 46 production Nimrod MR.1s flew on 28 June 1968 and the type entered service with No. 236 OCU at RAF St. Mawgan, Cornwall in October 1969. When all were delivered by August 1972 they equipped seven squadrons: Nos. 42 and 38(R) at St. Mawgan and 120, 201 and 206 at RAF Kinloss, Morayshire. No. 203 Squadron was based at Luqa, Malta, for patrolling the Mediterranean, but when Britain withdrew its forces from the island in 1979, the RAF was left with eight surplus aircraft from the last batch ordered. Of these, five were delivered to the RAF and three to British Aerospace for trials.

The MR.1 contained a fair amount of equipment inherited from the Shackleton, including the 1940s-designed ASV.21D radar and the galley. New kit included a US-supplied Emerson MAD and a Marconi-Elliot navigation system incorporating a digital computer with 8k memory. This would soon need replacing.



A view of one Nimrod MR.2 to another gives a good look at the 70m candlepower searchlight in the starboard external fuel tank and the 'Yellow Knife' ESM pods on the wingtip.

From 1975 the 35 remaining MR.1s were upgraded to MR.2 configuration and redeliveries to the RAF began in August 1979. All the main equipment items and sensors were changed. Core of the upgrade was a new GEC central tactical system with a new computer and three separate processors, for the navigation systems, radar and acoustic processors. The old radar was replaced by the Thorn EMI Searchwater, which was later upgraded with colour displays. The acoustics system was compatible with a wider range of active and passive sonobuoys.

The one Mk. 1 derivative was the R.1, which served in an electronic intelligence gathering role with No. 51 Squadron at RAF Wyton and later Waddington from 1973 to 2011. Three were built and a fourth was later converted from an MR.2.

Service of the MR.1 passed without a major accident, but there were four involving other variants. In 1980, MR.2 XV256 crashed after striking birds on take-off from Kinloss, killing the two pilots. In June 1944, XV257 suffered a bomb bay fire caused by a dislodged flare shortly after take-off from St. Mawgan. The crew was able to land it safely, but it was extensively damaged by fire and subsequently written off. R.1P XW666 had an engine fire on a test-flight out of Kinloss in May 1995. The aircraft made a successful ditching in the Moray Forth and all crew were rescued. In September that year, MR.2 XV239 crashed during an air display over Lake Ontario, Canada, killing all seven aboard.

The Falklands War in 1982 saw the fitting of Nimrods with inflight refuelling (IFR) probes to extend their range. This was done by Flight Refuelling Ltd in a remarkably quick 18 days, using surplus probes from retired Vulcan bombers, with at least one reportedly coming from a museum, Those 16 aircraft so equipped were designated MR.2Ps, although the P was dropped when the installation became universal.

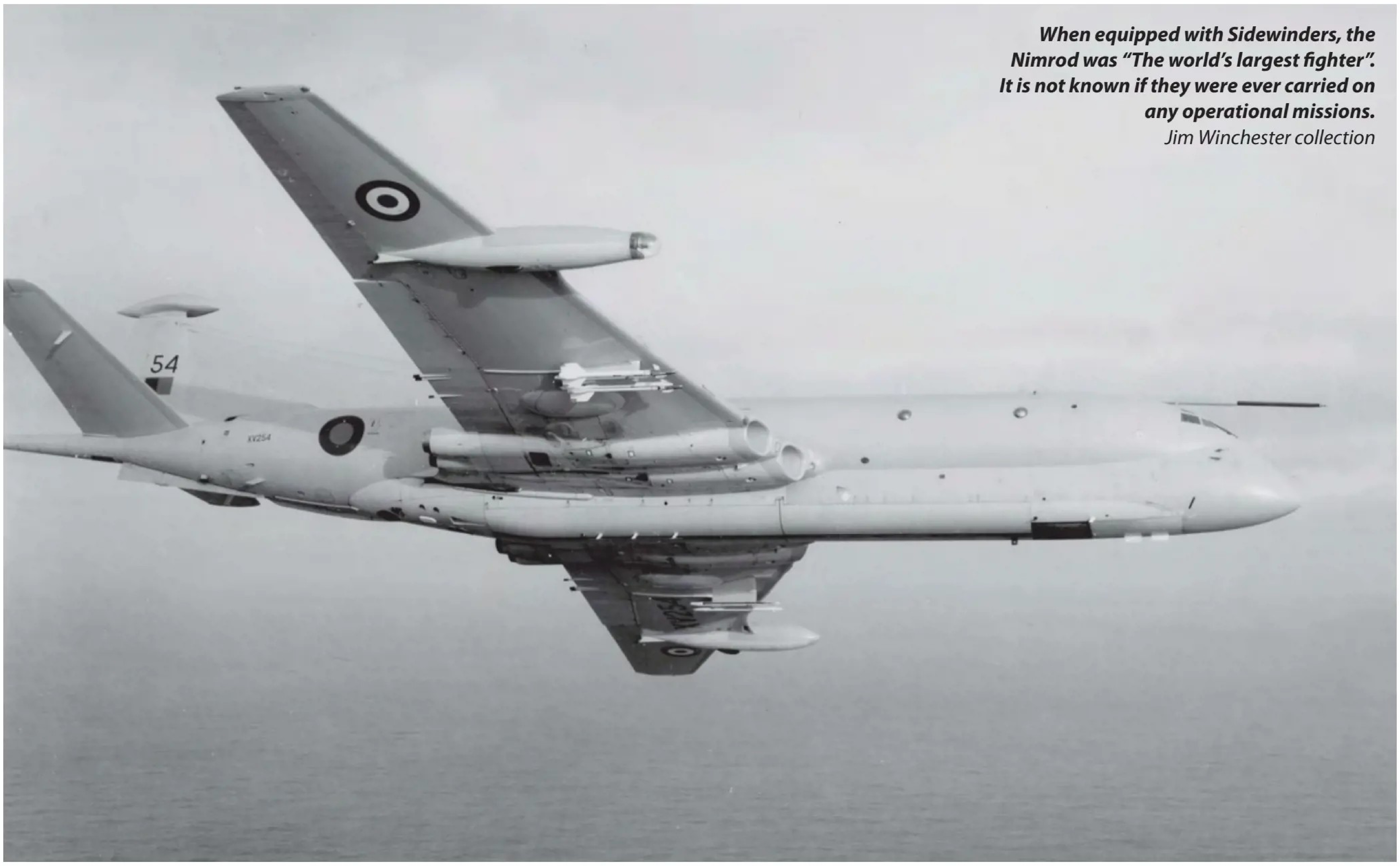
They were operated from Ascension Island, where they provided SAR cover for Harriers being delivered from the UK, dropped secret orders to Task Force ships, patrolled the waters around the island and made ASW sweeps ahead of ships heading south to the Falklands. The probe-equipped Nimrods were able to fly intelligence gathering sorties of up to 20hrs duration, approaching as close as 150 miles (241km) from Port Stanley and 60 miles (97km) from the Argentine coast.

In order to provide a measure of self-defence against fighters, or even to attack Argentine patrol aircraft, they were also fitted with adaptors for AIM-9 Sidewinder AAMs. The weapons bays were modified to carry bombs, Harpoon missiles and Sting Ray torpedoes, but these additional capabilities were not declared operational until after the conflict had ended.

Operation Granby, the UK contribution to the 1991 Gulf War, saw additional kit incorporated in the MR.2, including a datalink, chaff-flare dispensers, a towed countermeasures decoy, and a forward-looking infrared (FLIR) turret under the right wing. These were known as MR.2P(GM) for 'Gulf Mod'. Later, under Project Broadsword, six MR.2s were fitted with Wescam MX-15 sensor turrets, allowing real-time video to be shared with ground commanders.

The Nimrod's overland surveillance role was largely unknown to the public until XV230 was lost over Afghanistan in September 2006. The cause was attributed to a failure of the inflight refuelling system, with a pipe leaking fuel onto a hot air conditioning pack, causing a huge fire and the eventual breakup of the aircraft near Kandahar. The 14 killed included a Royal Marine and an Army paratrooper, indicating the Nimrod, which was based at Seeb, Oman was acting in cooperation with ground forces.

The fallout from this disaster included a report that heavily criticised the safety cultures at the Ministry of Defence and RAF. Many of the modifications made over the years, including the installation of the IFR system, had been done piecemeal and not to a common standard. The lack of a fire



When equipped with Sidewinders, the Nimrod was "The world's largest fighter". It is not known if they were ever carried on any operational missions.
Jim Winchester collection

suppression system contributed to the loss of the aircraft. Previous safety reviews of the Nimrod fleet had been inadequate.

The Nimrod AEW.3 airborne early warning aircraft programme is largely beyond the scope of the Nimrod's career as a maritime patrol and ASW aircraft, but had an effect on the wider fleet. All but one of the last eight aircraft plus four MR.1s were selected for conversion to AEW.3 standard with GEC Marconi radars in large radomes at the nose and tail. Unfortunately, these would not communicate with each other to provide a single picture, and interdepartmental relations within BAe were little better. The project was cancelled in 1986 after £1.5bn had been spent and the Shackleton carried on until 1991 when it was replaced by the US Boeing E-3 Sentry. All but one of the AEW airframes were scrapped.

The reduction in airframes put more strain on the remaining fleet, which was approaching obsolescence. The solution chosen was to rebuild airframes and in 1988 work began on the MR.2's successor, then known as Nimrod 2000, and later Nimrod MRA.4, the latter designation reflecting its greater attack capabilities, which were to include missiles such as the MBDA Storm Shadow. Although recognisably a Nimrod and remanufactured from MR.2 airframes, it was said to be 80 per cent different with an all-new wing, new Rolls-Royce Deutschland BR700 engines, Thales Searchwater 2000MR multi-mode radar and a new mission computer among many changes. Externally, larger intakes, auxiliary tail fins and winglets distinguished it from the MR.2

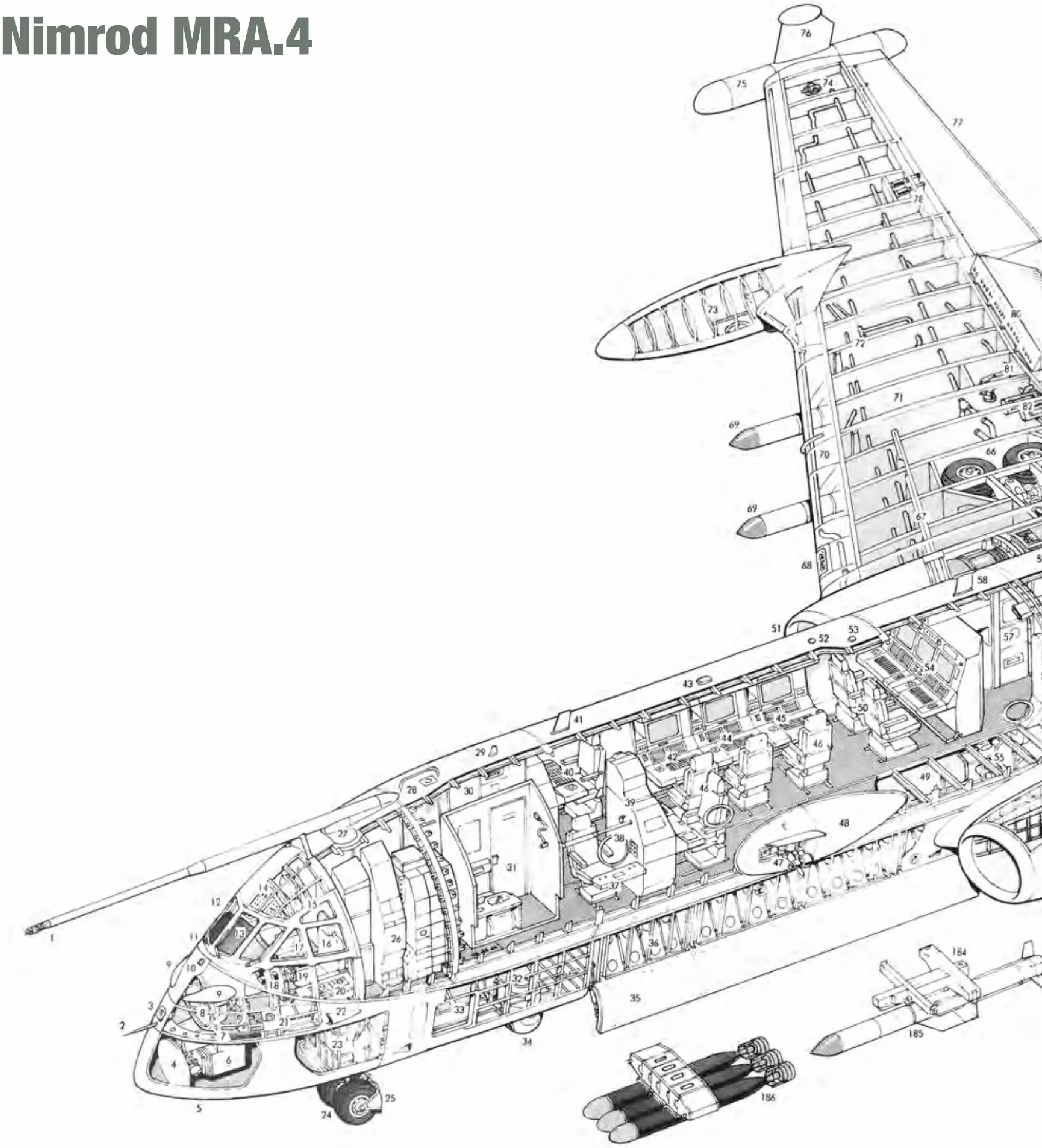
The prototype MRA.4 conversion (ZJ516, ex-XV247) flew on 26 August 2004 at BAE Systems Woodford. Successive defence cuts reduced the planned fleet from 21 MRA.4s to 16 to nine by the time the first production aircraft flew in September 2009. There were rumoured difficulties in fitting the new wings, designed with the aid of computers, to the Nimrod fuselages, which were more or less hand-built, although insiders deny this. There were certainly some engineering challenges and software integration proved more complex than anticipated. Costs spiralled to around £400m per aircraft, with anticipated operating costs for nine MRA.4s of £200m annually.

Three development and two production aircraft flew before the MRA.4 project was cancelled in the 2010 defence review, by then being nine years late and having consumed more than £3.5bn (£789m over budget). All but one airframe was scrapped. The MR.2 fleet was retired and Kinloss was given to the Army. The government ordered nine P-8A Poseidons five years later.

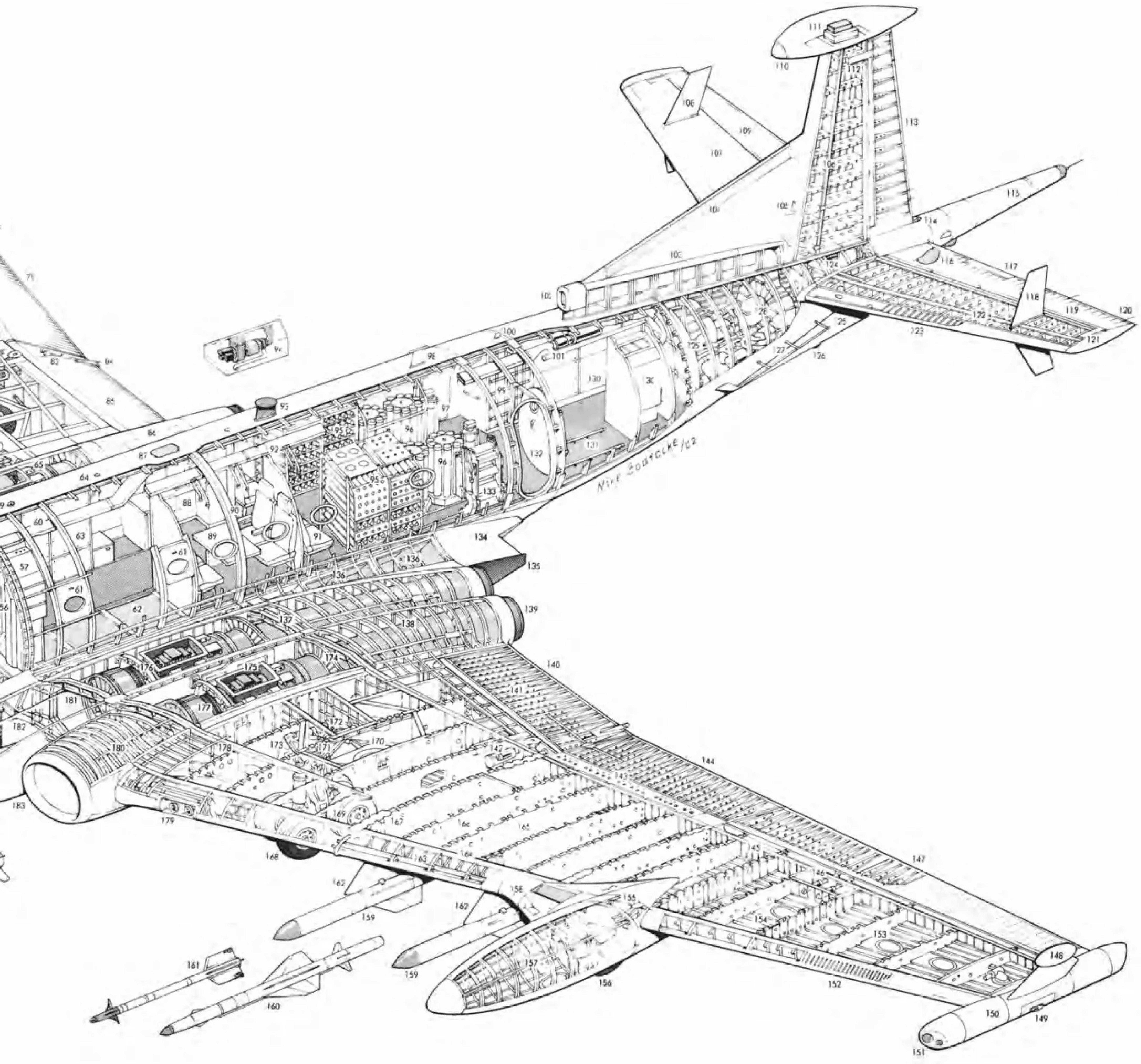
Nimrod MR.2

Crew:	12; two pilots, one flight engineer, two navigators, one Air Electronics Officer (AEO), two Weapon System Operators and four EW System Operators
Length:	126ft 9in (38.63m)
Wingspan:	114ft 10in (35.00m)
Height:	29ft 9in (9.08m)
Empty weight:	86,000lb (39,010kg)
Max T/O weight:	192,000lb (87,091kg)
Powerplants:	Four Rolls-Royce RB.168-20 Spey Mk.250 turbofans each rated at 12,140lb st (54.0kN) each
Max speed:	575mph (926km/h)
Service ceiling:	42,000ft (12,800m)
Range:	5,758 miles (9,266km)
Armament:	Torpedoes, conventional depth charges, B57 nuclear depth bombs, mines, freefall bombs, AIM-9 Sidewinder missiles

BAE Systems Nimrod MRA.4



1 Flight refuelling probe
2 Standby pitot head
3 Taxying light
4 Search radar scanner
5 Nose compartment radome
6 Scanner mounting
7 ILS antenna
8 Front pressure bulkhead
9 Forward ESM antenna fairings, port and starboard
10 MLS antenna
11 Windscreen wipers
12 Electrically heated windscreen panels
13 Instrument panel shroud
14 Overhead switch panel
15 Eyebrow window
16 Pilot's seat
17 Direct vision window panel
18 Instrument panel with multi-function EFIS displays
19 Control column yoke
20 Side console panel with nosewheel steering pillar
21 Pitot head
22 Avionics cooling ram-air intake
23 Nose undercarriage leg housing
24 Twin nosewheels, aft retracting
25 Fixed mudguards
26 Forward fuselage electrics and avionics racks
27 Cockpit roof hatch, inoperative with refuelling probe fitted
28 Starboard side forward entry door
29 TCAS antenna
30 Starboard side avionics racks
31 Crew toilet compartment
32 Ventral equipment bay
33 Nose undercarriage wheel bay
34 Electro-optical scanner turret
35 Forward weapons bay doors
36 Weapons bay 'pannier' sidewall structure
37 Port beam lookout windows
38 Bulged observation window
39 Radar workstation
40 ESM workstation
41 Combined VHF/UHF/IFF antenna
42 Communications workstation
43 MLS antenna
44 TACCO 1 workstation
45 TACCO 2 workstation
46 Fully adjustable individual crew seats on sliding rail mounts
47 Emergency ram-air turbine (RAT), extended
48 RAT housing, external to fuselage pressure cell
49 Underfloor fuel cells, fore and aft
50 Acoustic operators' seats (2)
51 Starboard outer engine air intake
52 GPS 1 antenna
53 MW sensor
54 Acoustic workstation
55 Underfloor hydraulics equipment bay
56 Front spar mounting fuselage main bulkhead
57 Electrical equipment racks, port and starboard
58 VHF/UHF antenna
59 Strobe light
60 Forward cabin conditioned air ducting
61 Escape hatches, port and starboard
62 Wing centre-section with integral fuel tank
63 Fuselage centre avionics equipment racks
64 GPS 2 antenna
65 Starboard outer engine bay
66 Starboard main undercarriage stowed position
67 Semi-span stub main spar
68 Leading edge landing lights
69 Starboard underwing missile carriage
70 Leading edge de-icing air ducting
71 Starboard wing integral fuel tankage
72 Fuel transfer and vent piping
73 Fixed external fuel tank
74 Vent surge tank
75 Wing tip ESM equipment pod
76 Winglet-mounted ESM antenna
77 Starboard aileron
78 Aileron tandem hydraulic actuators
79 Outboard plain flap segment, down position
80 Starboard airbrake panel (open), upper and lower surfaces
81 Fuel collector tank with boost pumps
82 Starboard hydraulic flap actuator
83 Flap interconnecting link
84 Fuel vent
85 Inboard flap segment, down position
86 Starboard engine exhaust fairing
87 ADF antenna
88 Galley
89 Dinette
90 Rear spar mounting fuselage main frame
91 Passenger seats (2)
92 Rear cabin conditioned air distribution duct
93 JTIDS antenna
94 Auxiliary power unit (APU) mounted in starboard wing root fairing
95 Sonobuoy racks, port and starboard
96 Rotary sonobuoy launchers (4)
97 Pressurised single sonobuoy launchers (2)
98 VHF/UHF antenna
99 Crew wardrobe
100 TACAN antenna
101 Conditioned air mixing ducts
102 Conditioning system ram-air intake
103 Extended fin-root fairing
104 Flush HF antennas
105 Fin de-icing air duct
106 Fin rib structure
107 Starboard
108 Auxiliary fins, above and below
109 Starboard elevator
110 Fin tip 'canoe' antenna fairing
111 SATCOM antenna
112 Rudder mass balance
113 Rudder rib structure
114 Tail navigation light
115 Extended tailcone
116 Aft ESM antenna
117 Elevator trim tab
118 Port auxiliary fins
119 Port elevator
120 Static dischargers
121 Elevator mass balance
122 Tailplane rib structure
123 Tailplane leading edge thermal de-icing
124 Fin and tailplane mounting bulkhead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125 Ventral fin
126 Tail bumper
127 HF antenna rail
128 Dual air conditioning packs
129 Fuselage rear pressure bulkhead
130 Rear fuselage avionics equipment racks, port and starboard
131 Tie-down rails, crew baggage stowage
132 Inward-opening rear entry door
133 Airstairs, stowed position
134 Wing root trailing edge fairing
135 Exhaust shroud
136 Wing root fuel tank bays
137 Rear spar exhaust duct forged and machined bulkhead
138 Jet pipes
139 Port engine exhausts
140 Port inboard plan flap segment
141 Flap rib structure
142 Flap hydraulic actuator
143 Port airbrake panel, upper and lower surfaces
144 Outer plain flap segment
145 Rear spar
146 Aileron dual hydraulic actuators
147 Port aileron rib structure
148 Port winglet-mounted ESM antenna
149 Port navigation light
150 Wingtip ESM pod
151 High and low band ESM antennas, fore and aft
152 leading edge thermal de-icing ducting
153 Outer wing panel rib structure
154 Wing bottom skin/stringer panel with access manholes
155 External fuel tank mounting
156 Tank protective bumper
157 Port external fuel tank
158 Slotted tank fairing
159 AGM-84 Harpoon air-to-surface anti-ship missile
160 ALARM anti-radiation missile (proposed)
161 AIM-9L Sidewinder
162 Port wing stores pylons
163 Inboard leading edge de-icing air duct
164 Front spar
165 Port wing integral fuel tank
166 Machined wing ribs
167 Outer wing panel joint rib
168 Port main undercarriage four-wheel bogie
169 Mainwheels with multi-plate carbon brakes
170 Wheel bay with pre-closing mainwheel door
171 Breaker strut and retraction linkage
172 Hydraulic retraction jack
173 Mainwheel leg pivot mounting
174 Engine bay firewalls
175 Full Authority Digital Engine Control (FADEC) unit
176 Main engine mounting beams
177 BMW Rolls-Royce BR710 turbofan engine
178 Port semi-span main spar
179 Port landing lights
180 Intake duct frame structure
181 Forged and machined intake duct bulkhead
182 Main spar to centre-section joint
183 Port engine air intakes
184 Weapons bay missile carrier/launcher
185 AGM-84 Harpoon, two in internal weapons bays
186 Stingray torpedoes

The Gardian is based on the Falcon 20 and serves with French forces in the South Pacific.

Dassault Falcon MPAs

Guardian, *Gardian* and *Albatros*

From the Falcon 20 of the 1960s to today's Falcon 2000, French defence and aerospace giant Dassault has long offered its business jets as maritime surveillance platforms.

The Dassault-Breguet Mystère 20 flew on 7 May 1963. It married the wing design of the Super Mystère fighter with a slender fuselage able to seat up to 12 passengers. It was marketed successfully in the US as the Dassault Falcon 20. After a long evaluation, in 1977 the US Coast Guard chose the design, which it designated HU-25A Guardian, to replace its last amphibians. USCG Guardians were completed in the USA with Garrett ATT-3-6-2 engines, Texas Instruments APS-127 radar and hard points for sensor pods or rescue packs. A total of 41 were delivered to nine Coast Guard Air Stations by December 1983. Of these, seven were later fitted with a SLAR pod on the fuselage and an APS-131 IR line scanner under one wing, becoming HU-25Bs with a specialised anti-pollution mission. Another nine were modified from 1988 to become HU-25C Interceptors with multimode APG-66 radar and a FLIR sensor for drug interdiction missions. These were assigned to Air Stations in Florida and Alabama. The Guardians were retired in 2014, replaced by larger but slower HC-144s.

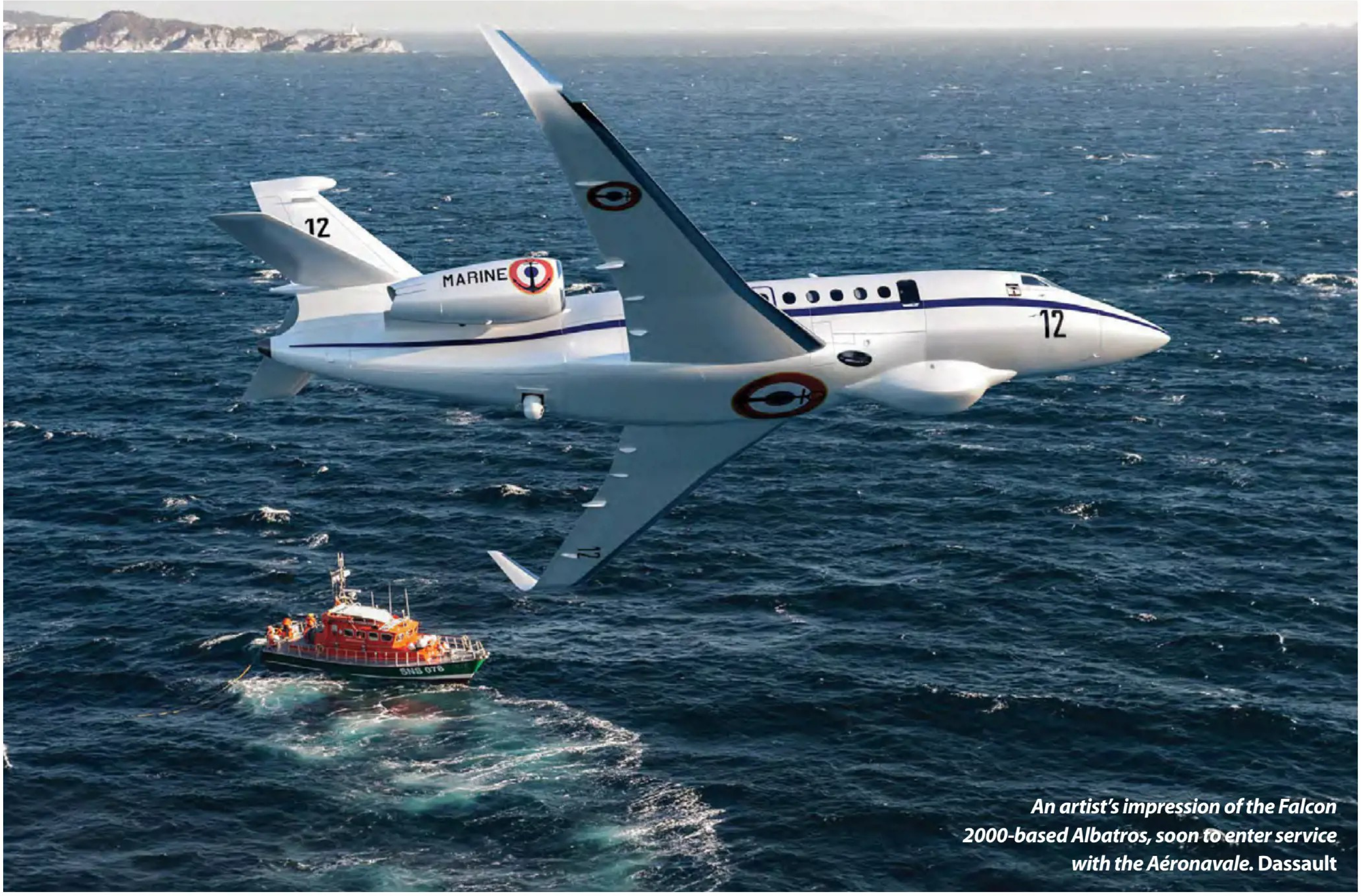
The French Navy's air arm, the *Aéronavale*, has used many Falcon variants. The Falcon 10 MER, a shorter version of the Falcon 20, entered service in 1975. Essentially the same as the corporate versions, it is mainly used by *Flotille* 57S to train pilots to operate in European airspace. *Aéronavale* fighter pilots learn to fly with the US Navy in America, but European airspace and procedures are so different that they need an extra course before beginning to fly the Rafale fighter in France.

Following the success of the USCG's Falcon 20G Guardians, a version was developed for the *Aéronavale* for use in its Pacific territories. On April 15, 1981, the first of Falcon 20H Gardian models flew, and was handed over the following month. With Thomson-CSF Varan radar and an Omega navigation system, they replaced the last Neptunes and were based in New Caledonia and Tahiti.

The Falcon 50M entered *Aéronavale* service in March 2000. The Falcon 50, first flown in November 1976, shares the same fuselage cross-section as the Falcon 20, but has a three-engined layout, with a third Garrett TFE731 turbofan mounted above the rear fuselage. The wing is of all-new design, incorporating a number of high-lift devices. The eight aircraft in service with *Flotille* 24F at Lann-Bihoué and comprise four Falcon 50Mi (intervention) variants, which are SAR-dedicated and four Falcon 50M Surmar, (Special maritime surveillance) models. The latter were modified in 2013-16 with Thales Ocean Master 100 radar, a multi-spectral sensor and an enlarged observation window. The cabin has three mission stations.

Today Dassault has a number of special mission aircraft based on their Falcon business jet family, including the Falcon 2000 MRA (Multi-Role Aircraft) based on the Falcon 2000 LXS and the Falcon 900 MPA derived from the Falcon 900 DX.

The Falcon 2000 business jet first flew in March 1993. In 2015 after an open competition



An artist's impression of the Falcon 2000-based Albatros, soon to enter service with the Aéronavale. Dassault

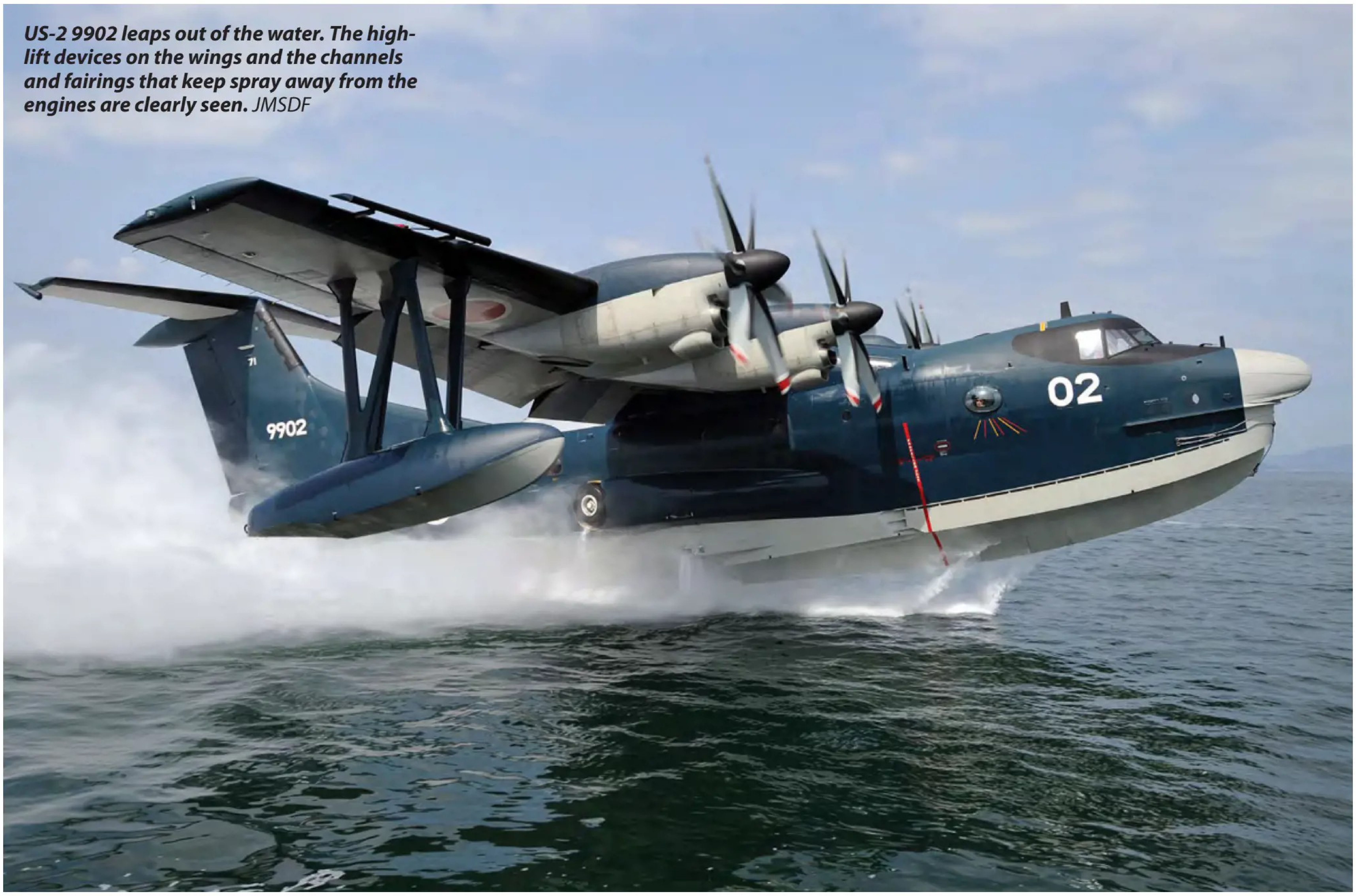
the Japan Coast Guard ordered three Falcon 2000MSA maritime surveillance aircraft, and three more by 2018 to replace a pair of Falcon 900s introduced 1989. The 2000 MSA's core mission equipment is by Thales and L3 Technologies, and the integration was performed at the latter's facility in Waco, Texas. The JCG has deployed the aircraft, which they have named *Churataka* (Beautiful Falcon) to Singapore and Indonesia to support anti-piracy efforts in the region.

In November 2020 the Falcon 2000LXS was chosen as the platform for the *Aéronavale's Albatros* Maritime Surveillance and Intervention Aircraft (AVSIMAR) programme. The requirement calls for 12 aircraft, with an initial order for seven to be delivered from 2025. The first airframe will be built in France with the remainder in India as part of offset arrangements related to the 2016 Rafale contract. Fitting of specialist equipment will be done in France.

Falcon 50SURMAR No. 36 wearing its test registration. The large observation window is a feature of many Falcon MPAs.

Dassault Falcon 2000 MSA

Crew:	Two pilots and two or four operators/ observers
Length:	66ft 4in (20.23m)
Wingspan:	63ft 5in (21.4m)
Height:	23ft 3in (7.1m)
Empty weight:	(11,300kg)
Max T/O weight:	(19,400kg)
Powerplants:	Two Pratt & Whitney Canada PW308C turbofan engines, each rated at 7,000lb st (31.14kN)
Max speed:	Mach 0.86
Service ceiling:	47,000ft (14,325m)
Range:	4,603 miles (7,408km)
Armament:	External stores capacity 4,850lb (2,200kg)



US-2 9902 leaps out of the water. The high-lift devices on the wings and the channels and fairings that keep spray away from the engines are clearly seen. *JMSDF*

ShinMaywa Amphibians

PS-1, US-1 and US-2

Just as other nations were retiring their last flying boats, Japan instigated development of large amphibians for ASW and patrol missions, and production has continued to the present day.

Formed in November 1959, the Shin Meiwa Industry Company was the successor to the Kawanishi Aircraft Company, which built over more than 2,800 aircraft up to 1945, notably the long-range H6K 'Mavis' and H8K 'Emily' flying boats. In 1953, former Kawanishi aeronautical engineers proposed an amphibian with better seaworthiness than existing types, able to operate in 3m swells. This was to be accomplished by a spray suppression system and a wing with various high-lift devices.

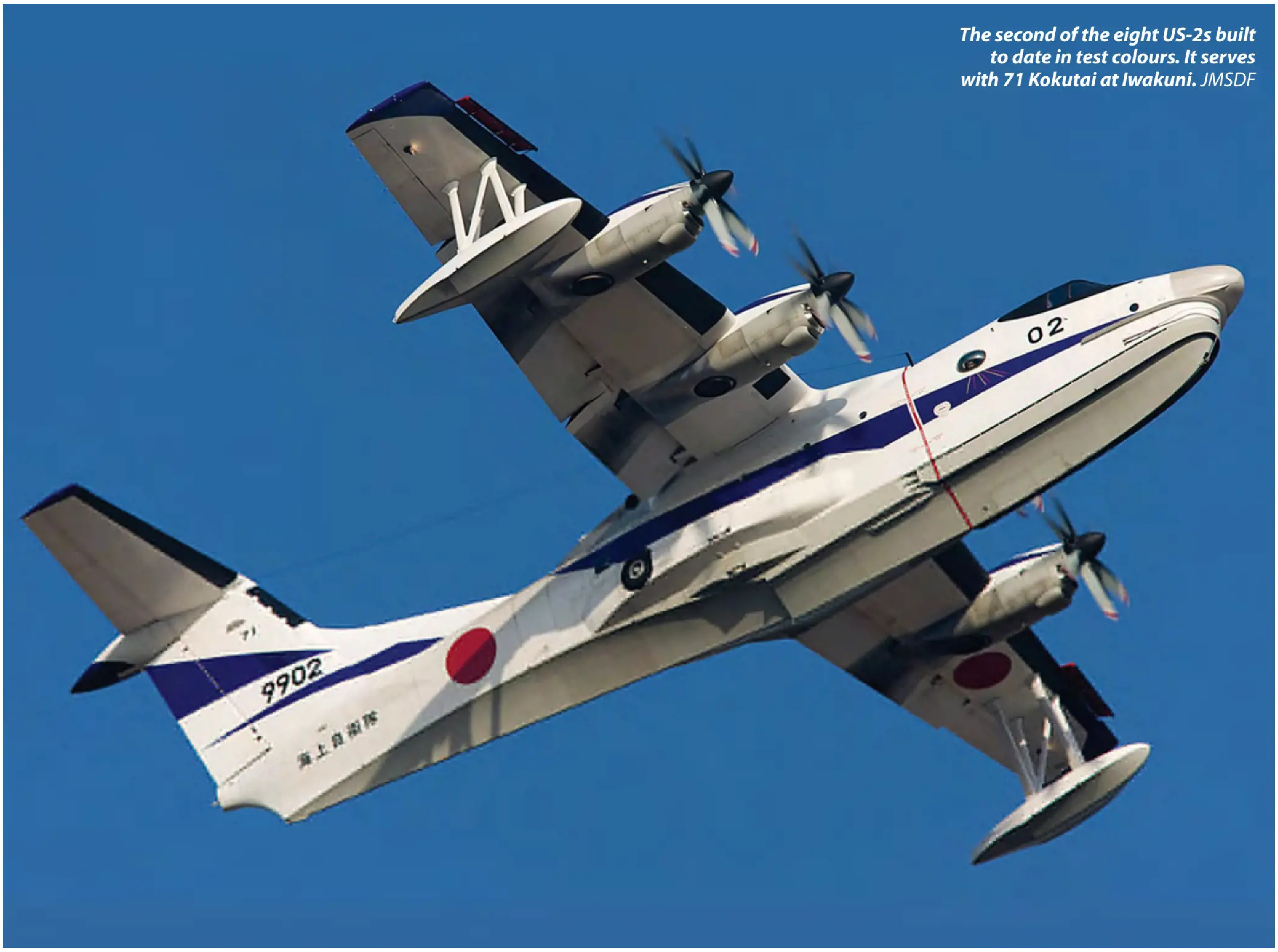
The US government supplied a Grumman Albatross amphibian for trials in 1960, after extensive modification it flew as the UF-XS in December 1962. The nose was extended and incorporated a system to reduce spray that was inspired by the design of fish gills. Water was channeled through openings under the forward part of the fuselage and ejected from openings to the side. High-lift devices on the wings, including boundary layer control supplied by thrust from two T58 turboshaft engines. Two additional radial engines were fitted and the tailplane was moved to the top of the fin.

Successful tests of the UF-XS led to a January 1966 order for development of a large flying boat for the Japan Defense Agency. It was broadly similar to the Martin Marlin, but had much better seakeeping and STOL characteristics.

On 17 October 1967 the first test flight of the PS-X (patrol seaplane, experimental) took place. This was a pure flying boat, which required beaching gear to bring it ashore. In trials it proved able to operate in wave heights up to 13ft (4m) and was handed over to the Japanese Maritime Self Defense Force (JMSDF) in August 1968 and was renamed the PS-1 in 1970. The 31st Kokutai at Iwakuni became operational with the type in March 1973. Series production amounted to 23 examples, the last being delivered in 1979. The PS-1 operated as an ASW patrol aircraft, but one disadvantage of the design was that it had to land on the water to operate its dipping sonar system.

By 1995, seven PS-1s had been lost in accidents, mostly in water landings, but also in an airshow accident and a collision. The high attrition prevented the formation of a planned second squadron.

Shinmeiwa (which more recently has styled itself ShinMaywa) was confident of orders for a successor patrol aircraft, but the JDA cancelled funding for further development in 1980. By this time, the company had created an amphibian derivative for search-and-rescue missions, initially designated PS-1S. Work began in 1973 and the first US-1 flew in October 1974. Conventional landing gear was specified to allow the transfer of survivors to ambulances. After much trial and error, the best location for the landing gear proved to be behind large bulges on the fuselage sides.



The second of the eight US-2s built to date in test colours. It serves with 71 Kokutai at Iwakuni. JMSDF

Power came from four IHI-built T64/P4C turboprops rated at 3,400hp (2,537kW). From the seventh aircraft, engine power was increased and the designation changed to US-1A.

PS-1s and US-1s were heavily involved in the search for wreckage and victims KAL 007, the Korean Air Lines Boeing 747 that was shot down by a Soviet fighter in September 1983. The US-1A had a radius of action of about 932 miles (1,500km) with a two-hour search.

Under the designation US-1A Kai, work on a modernised version began in 1996. The goals were improved flight control during takeoff and landing on water; improved environment for patients during transport; and enhanced open sea SAR capabilities. The US-2 incorporates improvements in weight reduction including in the main wings in addition to the adoption of fly-by-wire systems and cabin pressurisation. It can take-off from water in 918ft (280m) and land in 1,083ft (330m).

The prototype US-1A Kai flew on 18 December 2003 and was delivered to the JDA in March 2004. After evaluation of two test aircraft, the type was issued to the JMSDF as the US-2. They replaced US-1As on a one-for-one basis and the last US-1A was retired in December 2017.

The crew normally consists of two pilots, a flight engineer, a navigator/radar operator and medical attendants. Up to 20 seated survivors or 12 stretcher cases can be carried in the main cabin. The US-2's radius of action is extended to 1,900km) to date more than 1,000 people have been rescued in the waters around Japan and its outlying islands. One US-2 sank in April 2015.

Orders have been somewhat piecemeal, with funding for a single aircraft at a time provided approximately every other year and deliveries occurring at the same rate. The long production cycle leads to a certain degree of skills fade. ShinMaywa also produces products such as school buses and garbage trucks, with workers brought in from other business areas as necessary to work on the giant aircraft.

In recent years ShinMaywa has been marketing the US-2i international version, and firefighting and passenger versions have been proposed. From 2013, India showed interest in up to 12 US-2s for the navy and three for the coast guard. The Philippines has also been a prospective customer, but to date no export sales have been forthcoming.

ShinMaywa US-2

Crew:	11
Length:	109ft 1in (33.25m)
Wingspan:	108ft 9in (33.15m)
Height:	32ft 2in (9.80m)
Empty weight:	n/k
	Max T/O weight: 94,798lb (43,000kg)
Powerplants:	Four Rolls-Royce AE2100J turboprops rated at 4,591hp (3,423kW)
Max speed:	362mph (583km/h)
Service ceiling:	14,760ft (4,500m)
Range:	2,920 miles (4,700km)
Armament:	None

India's Tu-142ME fleet served 29 years without a major accident. 'ARK' on the fin refers to Arakkonam, the town where INS Rajali is situated. *Jim Winchester*

Tupolev Tu-95 and Tu-142 Bear

Long-Lived and Long-Ranged

Tupolev's *Bears* have been crossing the world's oceans for 70 years. The type is best known as a strategic bomber, but the maritime reconnaissance and patrol variants had important Cold War roles and continue to serve Russia today.

Known to NATO as the *Bear*-D, the Tu-95RT was a maritime reconnaissance aircraft with multi-sensor pallets; 53 were built or converted from standard bombers. They did not carry long-range missiles, but provided targeting information for surface vessels and submarines. The Tu-95RT was retired soon after the end of the Cold War.

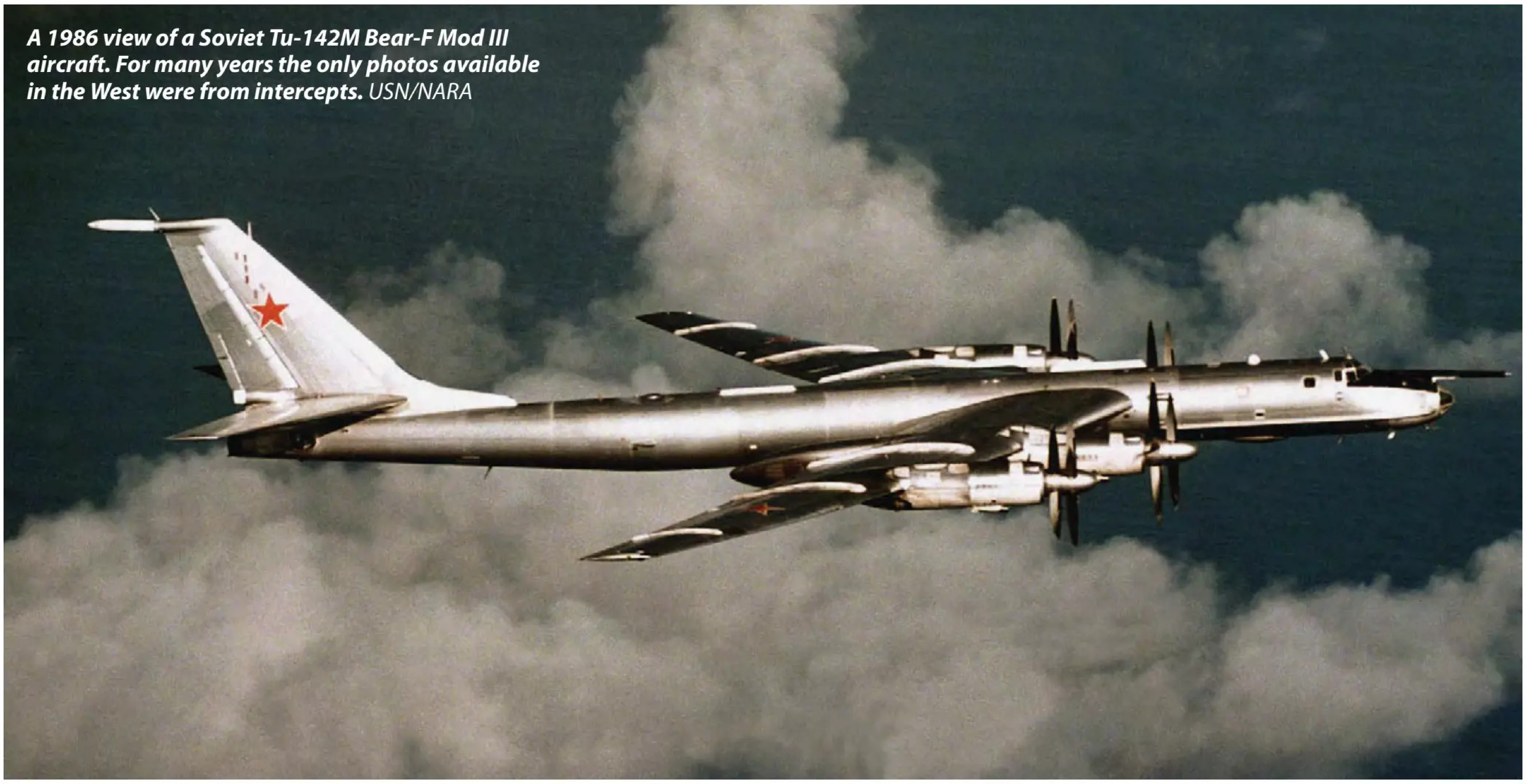
The advent of operational nuclear ballistic missile submarines from 1960 put the Soviet Union at risk from a first strike that could not be countered. The Il-38 May lacked the range to reach the subs' patrol boxes. Andrei Tupolev, head of the design bureau that bore his name, independently began work on a version of the Tu-95 to close the ASW gap in the Atlantic. This in fact would be two versions, a hunter with the sensors and a killer with the weapons, but the Tu-95PLO proposal was quickly rejected. Instead the navy wanted a single ASW derivative as quickly as possible, fitted with the *Berkut* system of the Il-38, plus signals intelligence (SigInt) equipment and the ability to used unpaved runways.

Using the Tu-95RT as a baseline, the wings were modified, the tailplane increased in area, the upper and lower turrets were removed and the wing fuel tanks strengthened. The *Berkut*-95 ASW suite was a minimum-change derivative of the one on the Il-38. It was coupled to the autopilot to allow flight in automatic mode to the coordinates of potential targets. The main sensor is the belly radar for detecting surfaced submarines and periscopes, while various types of sonobuoys can search for submerged threats. As many as 440 can be carried if there is no other ordnance.

ASW weaponry included three PLAT-1/2 guided torpedoes or one 5F48 Scalp nuclear depth charge. The weapons bay could also accommodate up to six UDM or 10 RM-1 sea mines.

Design work began in 1963, but the first flight of what was by then designated Tu-142 did not take place until 18 June 1968. The first production-standard Tu-142 was completed in the spring of 1970. Early operations proved it to be overweight and shorter-ranged than specified. To address this, unnecessary equipment was deleted, the extra-strength main undercarriage was replaced with standard units, and more efficient propellers were fitted. This resulted in a 8,155lb (3,700kg) weight saving and a range increase to 7,768 miles (12,500km) up from 6,214 miles (10,000km), but still short of the originally specified 8,745 miles (14,000km).

By now the ASW system, using technologies from the 1950s and '60s, was dated and a new suite, named *Korshun*, was tested from 1975. The modified version became the Tu-142M



A 1986 view of a Soviet Tu-142M Bear-F Mod III aircraft. For many years the only photos available in the West were from intercepts. *USN/NARA*

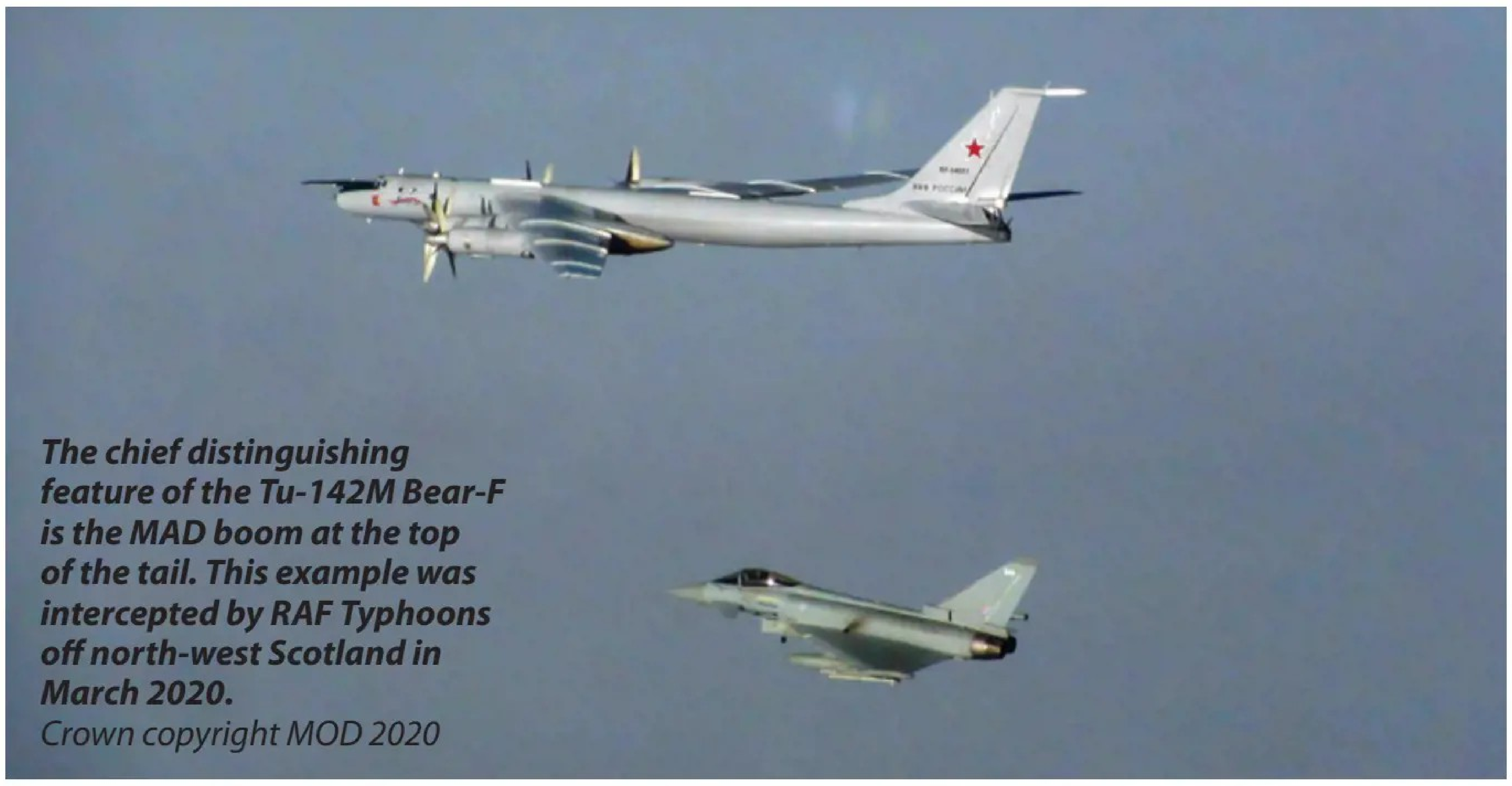
(NATO *Bear*-F Mod 3) and had a new search radar, a 'Penguin' infrared imager, a Visla MAD and four new sonobuoy types.

The Bear was the fastest turboprop aircraft in the world and one of the longest-ranged warplanes. Soviet Naval Aviation's Northern Fleet had a major bomber base at Kipelovo between Moscow and Archangelsk. A regular route was to fly from Olenegorsk in northern Russia around the Kola Peninsula, down the coast of Norway, past the UK and then on to Cuba. The next stage of the mission might cross the Atlantic to land in Luanda, Angola then return by flying back to Cuba and then up the US East Coast.

in the Russian Far East, Bears were based at Kamenny Ruchey (also known as Mongokhto) opposite Sakhalin Island and Khorol naval air station further south and inland west of Hokkaido. From these bases they sent patrols out over the Pacific and Sea of Japan. In 1979 Pacific Fleet *Bears* also began operating from Da Nang and Cam Ranh in Vietnam. As of 2024, there were still approximately 32 Tu-142s in Soviet Navy service and western air forces continue to intercept them over the Atlantic and Pacific Oceans.

India was the only export customer. In 1984 a contract was signed for eight Tu-142MEs. This was a standard Tu-142M with some features removed, such as the provision for nuclear depth charges and the Soviet Navy communications system. The aircraft were all in service with INAS 312 at INS Hansa, near Goa by 1988. They were active that year on Operation Cactus, when India intervened to put down a coup in the Maldives and the plotters attempted to escape in a hijacked freighter. INAS 312 was also deployed during the 1999 Kargil conflict and the 2002 military standoff with Pakistan, and flew anti-piracy missions in the Arabian Sea. The squadron moved to INS Rajali in Tamil Nadu in 1992.

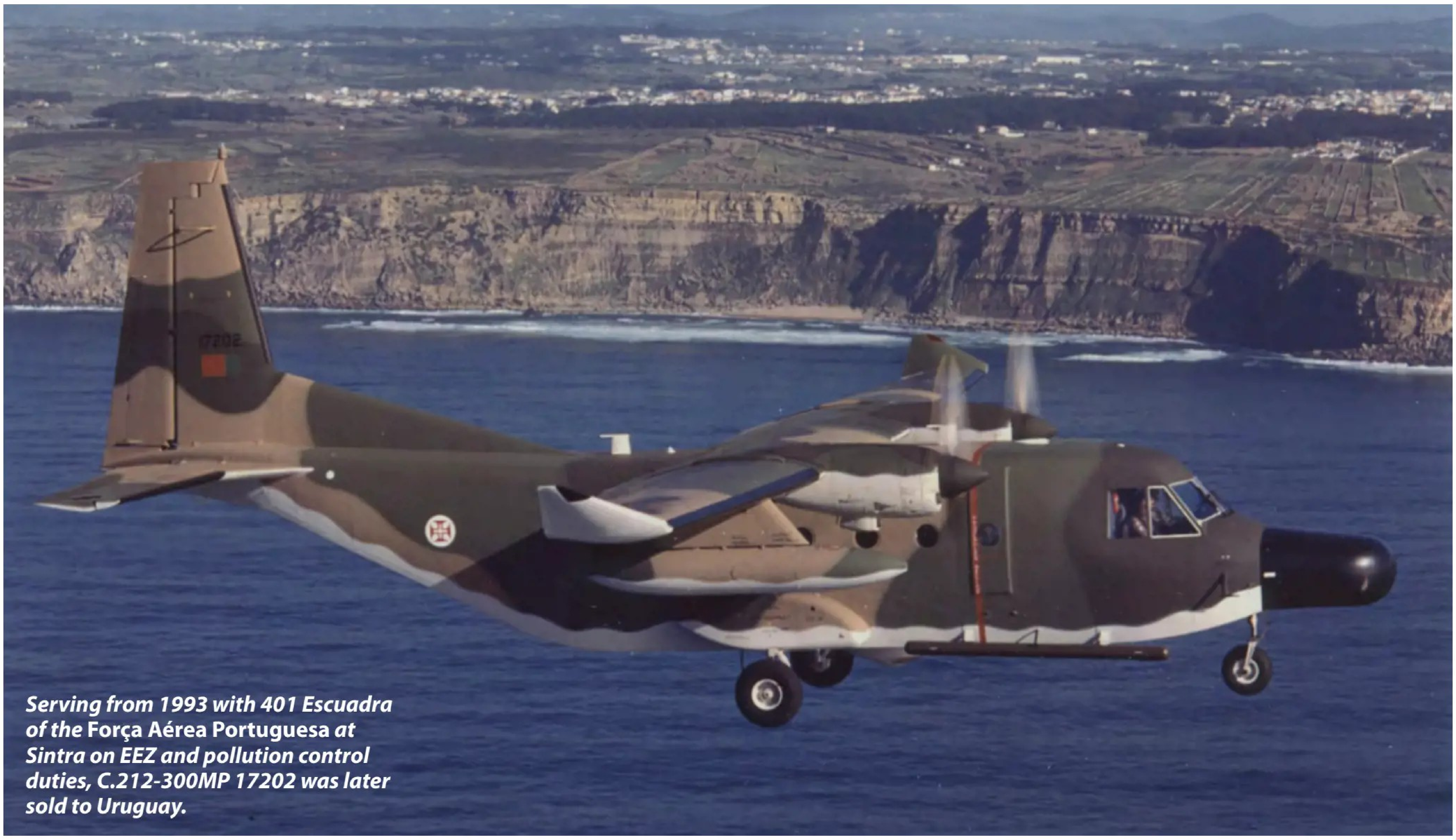
There were plans to give the Indian *Bear*s a major upgrade, but Moscow and Delhi could never agree on price or timescale. A series of smaller rolling upgrades were performed instead. In the early 2000s, new ESM and networking equipment was added, and in 2004-2008 an Israeli-made ELTA EL/M-2022(V)3 radar was fitted. The Indian aircraft's main weapon was the APR-2E torpedo. The Tu-142s never had an operational anti-surface weapon, although trials were conducted with the BAe Sea Eagle. In March 2017 the last Indian Tu-142s were retired.



The chief distinguishing feature of the Tu-142M Bear-F is the MAD boom at the top of the tail. This example was intercepted by RAF Typhoons off north-west Scotland in March 2020.
Crown copyright MOD 2020

Tupolev Tu-142M Bear-F

Crew:	11
Length:	174ft 6in (53.20m) with probe
Wingspan:	164ft 1in (50.04m)
Height:	39ft 9in (12.12m)
Empty weight:	n/k
Max T/O weight:	370,000lb (167,877kg)
Powerplants:	Four Kuznetsov NK-12MV turboprops rated at 15,000shp (11,000kW)
Max speed:	531mph (855km/h)
Service ceiling:	n/k
Range:	7,328 miles (11,800km)
Armament:	Two AM-23 23mm cannon in tail turret



Serving from 1993 with 401 Escuadra of the Força Aérea Portuguesa at Sintra on EEZ and pollution control duties, C.212-300MP 17202 was later sold to Uruguay.

CASA C.212 Aviocar

Inshore Patroller

The dumpy Aviocar is not the most glamorous of military aircraft but has supplied several smaller air arms and agencies with a cost-effective littoral surveillance capability.

Designed as a tactical airlifter with short take-off and landing (STOL) characteristics, the CASA C.212 Aviocar prototype first flew on 26 March 1971. The high wing is mounted above a boxy fuselage with a rear loading ramp and the 212 is able to accommodate 16 equipped troops or 19 passengers. The -100 was followed by the -200 in 1979 with more powerful Garrett turboprops. The Series 300 followed in 1984, adding winglets and being offered in -300MP maritime patrol configuration. Nearly 60 MP versions were sol by 1992; customers included Angola, Argentina, Spain and Portugal. In service with the Portuguese Air Force, the type was known as the Patrullero and fitted with Telephonics APS-128 radar and an Ericsson SLAR system. The two aircraft were replaced by C.295Ms and sold to Uruguay in 2014. Uruguay has also acquired two similar ex-Swedish Coast Guard aircraft.

The Mexican Navy took delivery of the first of eight C.212-200s in July 2004. The aircraft are fitted with Raytheon SeaVue radar, the EADS CASA fully integrated tactical system (FITS), and FLIR Systems SAFIRE II thermal imagers.

Although configurations vary, C.212 MPs usually have a mission sensor operator and observer in the main cabin. There are also up to ten passenger seats or rest beds. The operator has access to the radar, FLIR/TV, moving map and communications. The most common radar is the Thales Ocean Master, while other equipment can include searchlights and loudspeakers.

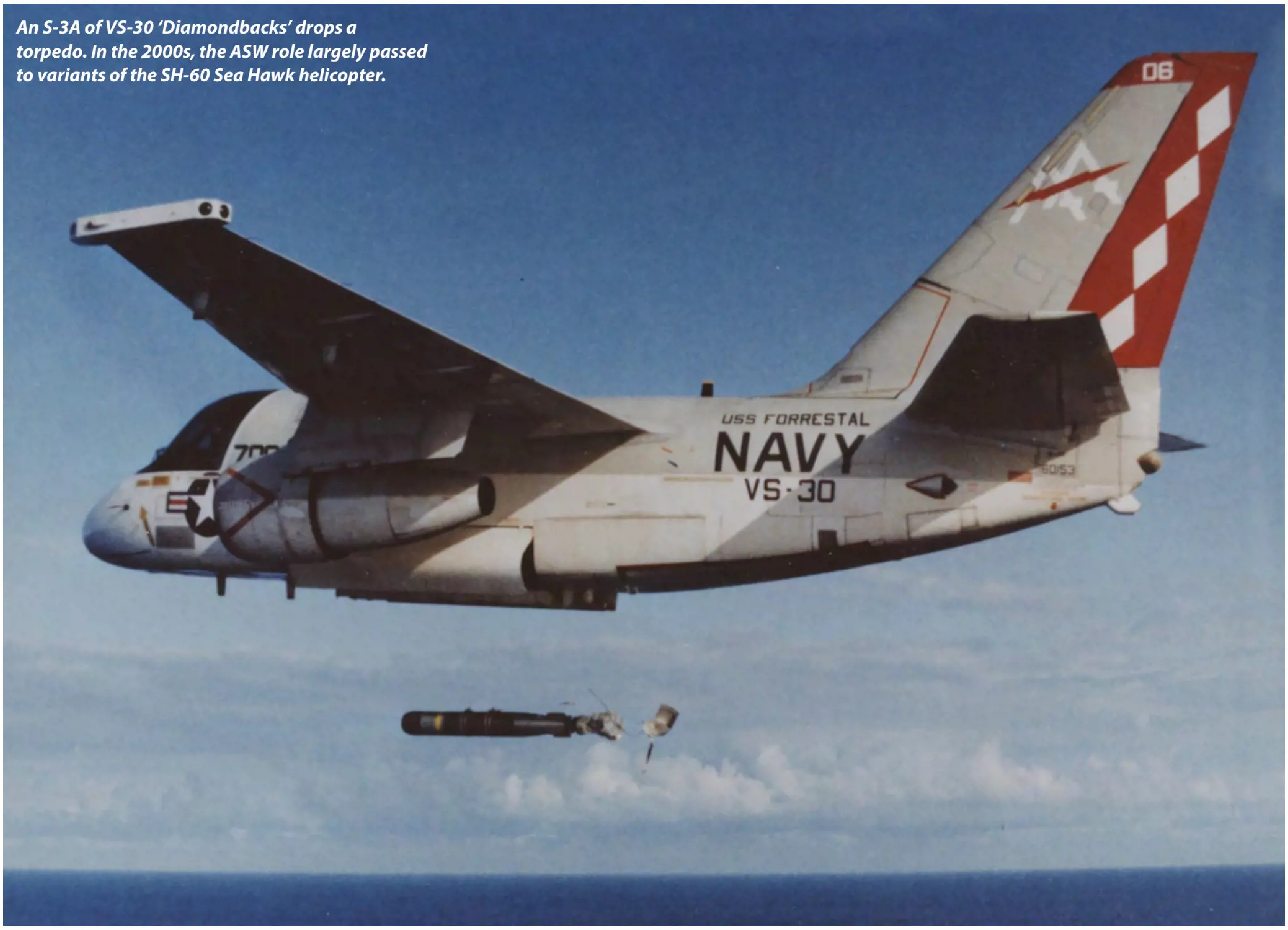
The Series 400 was introduced in 1997. Initial C.212-400MP deliveries were to the Spanish Ministry of Agriculture, Fisheries and Food (MAPA) in December 1998. They had received a third by May 2003 and use the type for surveillance of fishing fleets in Spanish waters, operating over large areas from the Iberian Peninsula to the Mediterranean and Canary Islands.

The Suriname Air Force bought two -400MPs equipped with Telephonics RDR-1500 radar in 1999. They were sold on the civilian market in 2014 and then on to Botswana. Other customers include the South Korean Coast Guard and the Vietnam Marine Police.

In November 2006, EADS (now Airbus) signed an agreement with Indonesian Aerospace (now PT Dirgantara) to carry out the final assembly of C.212-400s. Spanish production ended after 371 aircraft and PT Dirgantara now produces a modernised version as the NC212i and offers it in various configurations including for maritime surveillance and pollution control.

Airbus C.212 Series 400M

Crew:	Two pilots, two mission crew
Length:	53ft 0in (16.15m)
Wingspan:	66ft 7in (20.28m)
Height:	21ft 8in (6.60m)
Empty weight:	8,333lb (3,780kg)
Max T/O weight:	17,857lb (8,100kg)
Powerplants:	Two Garrett TPE331-10R-513C turboprops each rated at 900hp (690kW)
Max speed:	224mph (361km/h)
Service ceiling:	26,000ft (7,925m)
Endurance:	8hr 30min with external fuel tanks
Armament:	Fuselage hardpoints for gun or rocket pods



An S-3A of VS-30 'Diamondbacks' drops a torpedo. In the 2000s, the ASW role largely passed to variants of the SH-60 Sea Hawk helicopter.

Lockheed S-3A Viking

Jet Sub-Hunter

The Viking was designed to hunt submarines from US carrier decks, but found itself performing many other roles, including signals intelligence, ground attack and as an airborne gas station.

A replacement for the piston-engined Grumman S-2 Tracker was well overdue by the late 1960s, but required new ASW systems and efficient turbofan engines to meet the threat from new, quiet Soviet submarines. Won by Lockheed in August 1969, the VSX (sea control aircraft, experimental) competition sought a modern aircraft able to operate from Essex-class carriers, and although development of the S-3 Viking was comparatively swift, these ships had all been retired from combat duties by the time it was in service.

The Viking was a high-winged aircraft powered by two underslung TF34 turbofans, which led to the nicknames 'Hoover' and 'War Hoover'. The wings folded over the top of the fuselage and the tail fin hinged horizontally for carrier storage. The nose contained a AN/APS-116 radar, and a magnetic anomaly detector (MAD) boom could be extended from the base of the tail.

A weapons bay could carry bombs, depth charges or torpedoes. Up to 60 sonobuoys were housed in a launcher array on the lower rear fuselage. The four crew positions comprised one pilot, a Copilot Tactical Coordinator (COTAC), an acoustic sensor operator and a non-acoustic sensor operator. The COTAC had a clear windscreen beside the pilot, but the back-seaters had small windows and opaque frangible panels above their heads, which they would pass through in the event of an ejection.

On 21 January 1972 the first YS-3A, 157992, flew at Palmdale, California. It was followed by seven more prototype and preproduction aircraft. One YS-3A crashed during testing. Carrier qualifications began in November 1973 and service began with training unit VS-41 'Shamrocks' in February 1974, the Viking becoming operational with VS-21 'Fighting Red Tails' in 1977.

The turbofans gave excellent fuel economy and long flight endurance, suiting the Viking to other roles. A transport version was developed in 1976 to supplement the Grumman C-2A Greyhound in the Carrier Onboard Delivery (COD) role. Electronic and ASW equipment was removed and the US-3A could carry six passengers and a loadmaster and up to 4,680lb (2,125kg) of freight internally, as well as cargo in underwing pods. Only seven US-3 conversions were made and the variant was retired in the early 1990s.

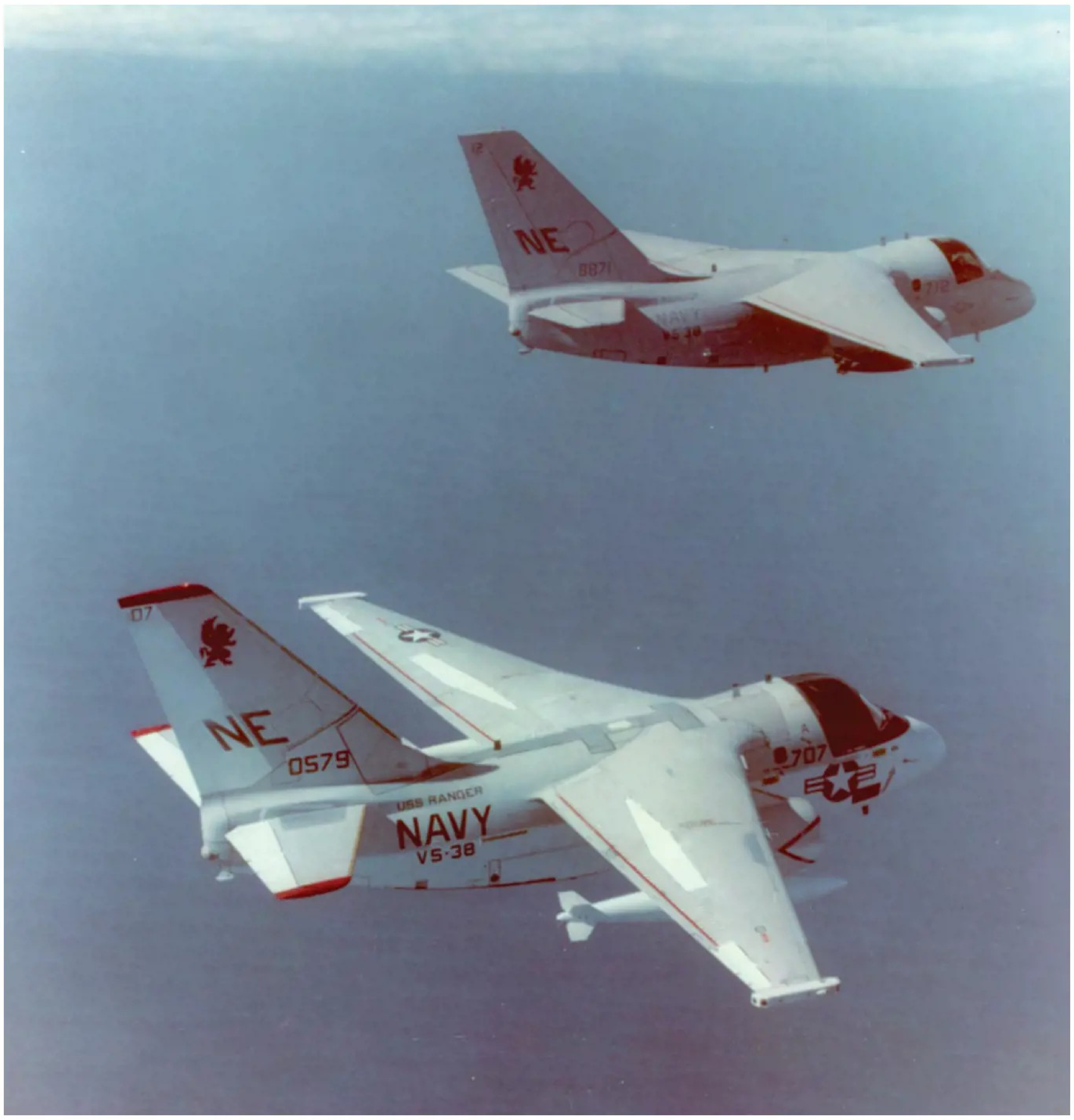
From 1989 a further 16 Vikings were converted to the ES-3A Sea Shadow for the signals intelligence (Sigint) mission. The sonobuoy launchers and MAD gear were removed and a Texas Instruments AN/APS-137(V)1 radar with an inverse synthetic aperture radar (ISAR) imaging capability added. The two Sigint Viking squadrons, VQ-5 and VQ-6 supplied detachments to carrier air wings, but were disestablished in 1999. The ASW mission became less important, taken over largely by SH-60 helicopters aboard escort ships. When the KA-6D Intruder retired, the Viking was given the mission of refuelling tanker, topping up the fuel tanks of aircraft after launch on a long-range mission and before they made a carrier approach.

The last of 187 Vikings produced was delivered in August 1978. From 1988 119 S-3As were converted to S-3Bs. These had an improved FLIR system and radar, chaff/ flare dispensers and AGM-84 Harpoon missile capability. In Operation Desert Storm, S-3 Vikings sank several Iraqi warships trying to escape to Iran and carried out conventional overland bombing missions against targets such as radar sites with unguided bombs and cluster bombs.

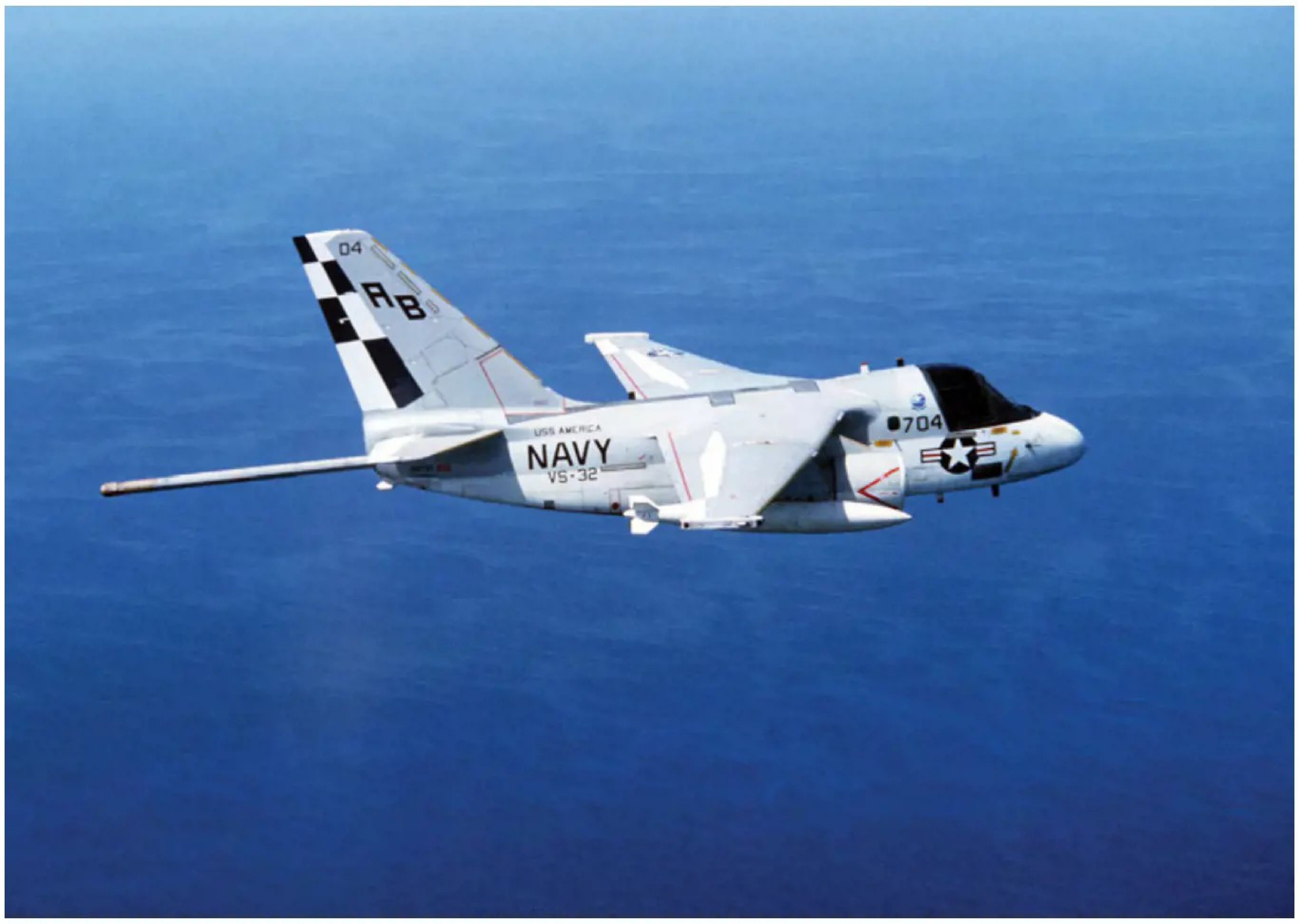
US president George W. Bush landed in an S-3B aboard the USS Abraham Lincoln on 1 May 2003 as it neared San Diego on its return from operations in the first phase of Operation Iraqi Freedom. The VS-35 aircraft was designated 'Navy One' for the flight. The sea control squadrons retired the Viking in 2009, but VX-30 at Pt Mugu, California, flew two S-3Bs on range control duties until 2016. Another was assigned to NASA's Glenn Research Center at Cleveland, Ohio from 2004 to 2021.

Lockheed S-3A Viking

Crew:	3-4
Length:	53ft 4in (16.26m)
Wingspan:	68ft 8in (20.93m)
Height:	22ft 9in (6.93m)
Empty weight:	27,558lb (12,500kg)
Max T/O weight:	47,598lb (21,590kg)
Powerplants:	Two General Electric TF34-GE-400 turbofan engines rated at 9,250lb st (41.1kN) each
Max speed:	518mph (833km/h)
Service ceiling:	40,000ft (12,192m)
Range:	2,630 miles (4,232km)
Armament:	Up to 4,900lb (2,200kg) ordnance, including AGM-84 Harpoon, AGM-65 Maverick and AGM-84 SLAM and SLAM(ER) missiles, torpedoes, rockets and bombs and B57 nuclear depth bombs



A pair of S-3As from VS-38 'Red Griffins' illustrates the change from colourful markings to the Tactical Paint Scheme in the late 1980s. The lead aircraft is carrying bombs or Quickstrike mines under the wings.



MAD boom extended, an S-3A of VS-32 'Maulers' off USS America hunts for submarines in the Atlantic, May 1982. *US Navy*

Ireland's two CN235MPs entered service in 1994 and are used for fisheries patrol, SAR top cover and parachuting operations.

CASA/IPTN EADS/Airbus CN.235 and 295 MPAs

International Persuaders

A joint venture between CASA of Spain and IPTN of Indonesia, the CN.235 has been a popular military transport, which has also seen success in the maritime patrol role.

In 1980 Industri Pasawat Terbang Nusantara (IPTN) and CASA formed a joint company, Airtech, and began work on a twin-engined transport broadly similar, but larger than the C.212, which had been licence-produced in Indonesia for several years. Spanish and Indonesian prototypes flew on 11 November and 30 December 1983, respectively. Although intended as a 45-seat airliner as well as a military transport, the great majority have gone to military and government customers.

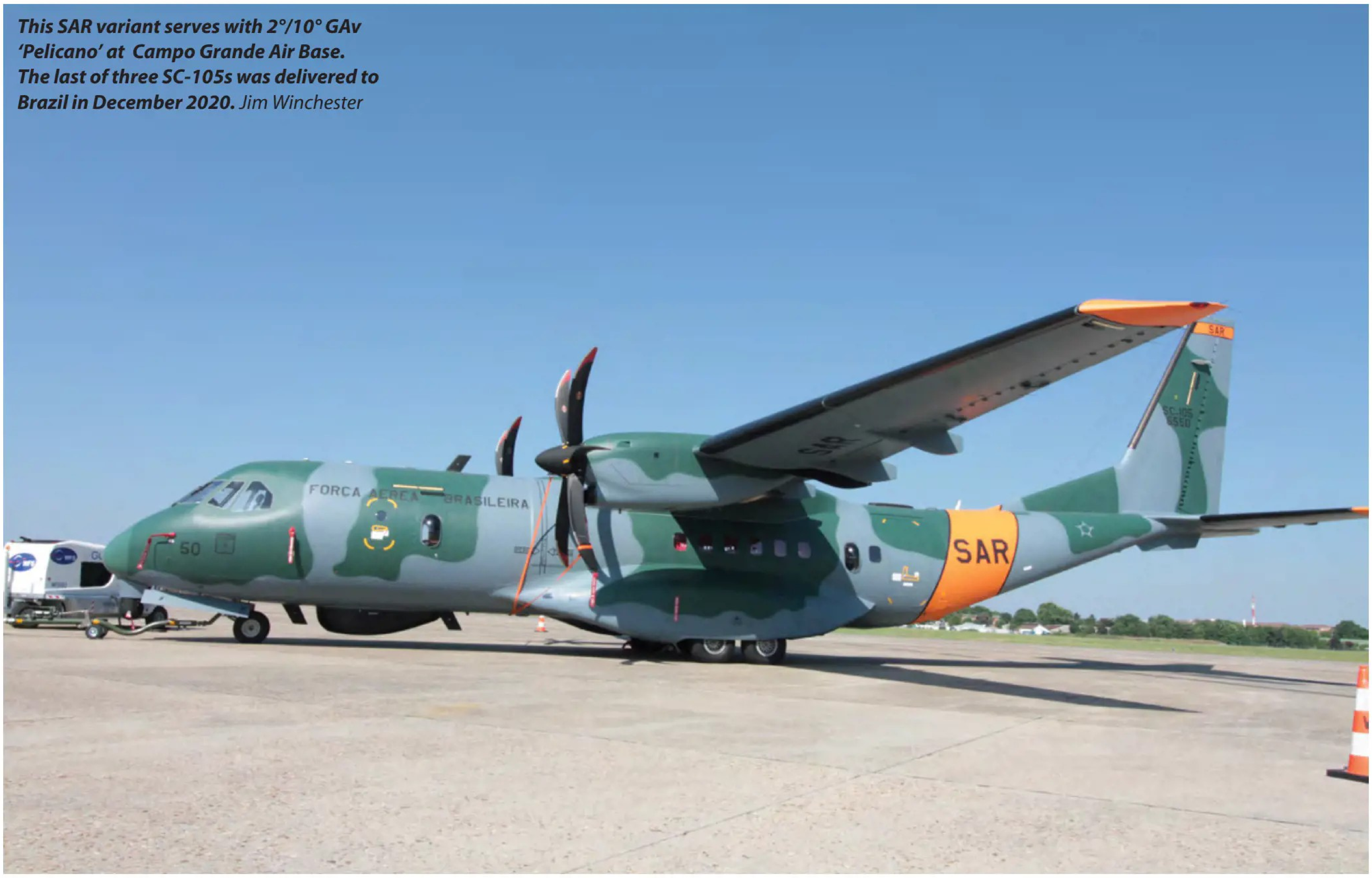
The standard CN235M has a high-set wing, a pressurised fuselage of circular cross-section with a rear loading ramp and the main wheels mounted in fuselage sponsons to allow landings on semi-prepared surfaces. The engines on the main production Series 100 were General Electric CT7-9C turboprops rated at 1,750shp (1,305kW) and driving four-bladed Hamilton Sundstrand propellers

The CN235MP is a basic maritime patrol variant with limited sensor capability. The Irish Air Corps bought two CN235MPs in 1994 and Spain has acquired five (two for the Maritime Security Agency and three for the Guardia Civil). Eight Spanish Air Force transports have been upgraded to MP standard for SAR duties. Turkey (now Türkiye) purchased six CN235MPs for its navy and three for its coast guard, assembling them at Ankara. In 2002 they agreed a programme to upgrade them to Miltem II standard, similar to the navy's ATR 72MPAs.

IPTN developed the CN235MPA, a more capable version with either a lengthened nose containing APS-504 radar or the standard nose and a belly radar. The Indonesian Navy ordered three of a planned six in 2000 to be equipped with a Thales Airborne Maritime Situation and Control System (AMASCOS). South Korea exchanged two submarines with Indonesia for eight CN235MPAs for its coast guard.

To replace the HU-25 Guardian, the US Coast Guard purchased 18 examples of the HC-144 Ocean Sentry in 2006. They were delivered with a Lockheed Martin Mission System Pallet roll-on, roll-off electronics suite. With greater than ten-hour endurance and used in the medium range surveillance role from four Air Stations, from 2016-2024 the HC-144As were upgraded to HC-144Bs with the US Navy's Minotaur mission system, which is also being integrated on the Coast Guard's HC-130J and HC-27J fleets.

The C295 is a stretched derivative of the 235 developed initially by CASA (later EADS, now Airbus Defence) from 1996. The first prototype flew on 28 December 1997 and 100 examples had been delivered by late 2013. The majority are transport variants, but gunship, armed



This SAR variant serves with 2°/10° GAv 'Pelicano' at Campo Grande Air Base. The last of three SC-105s was delivered to Brazil in December 2020. *Jim Winchester*

ISR and AEW versions have been offered. The maritime patrol C295 equipped with the FITS (Fully Integrated Tactical System) has sold to a number of customers, including Portugal (five) and Oman (four). The marketing name Persuader has been used, backed up by provision to carry AM39 Exocet missiles on underwing hardpoints.

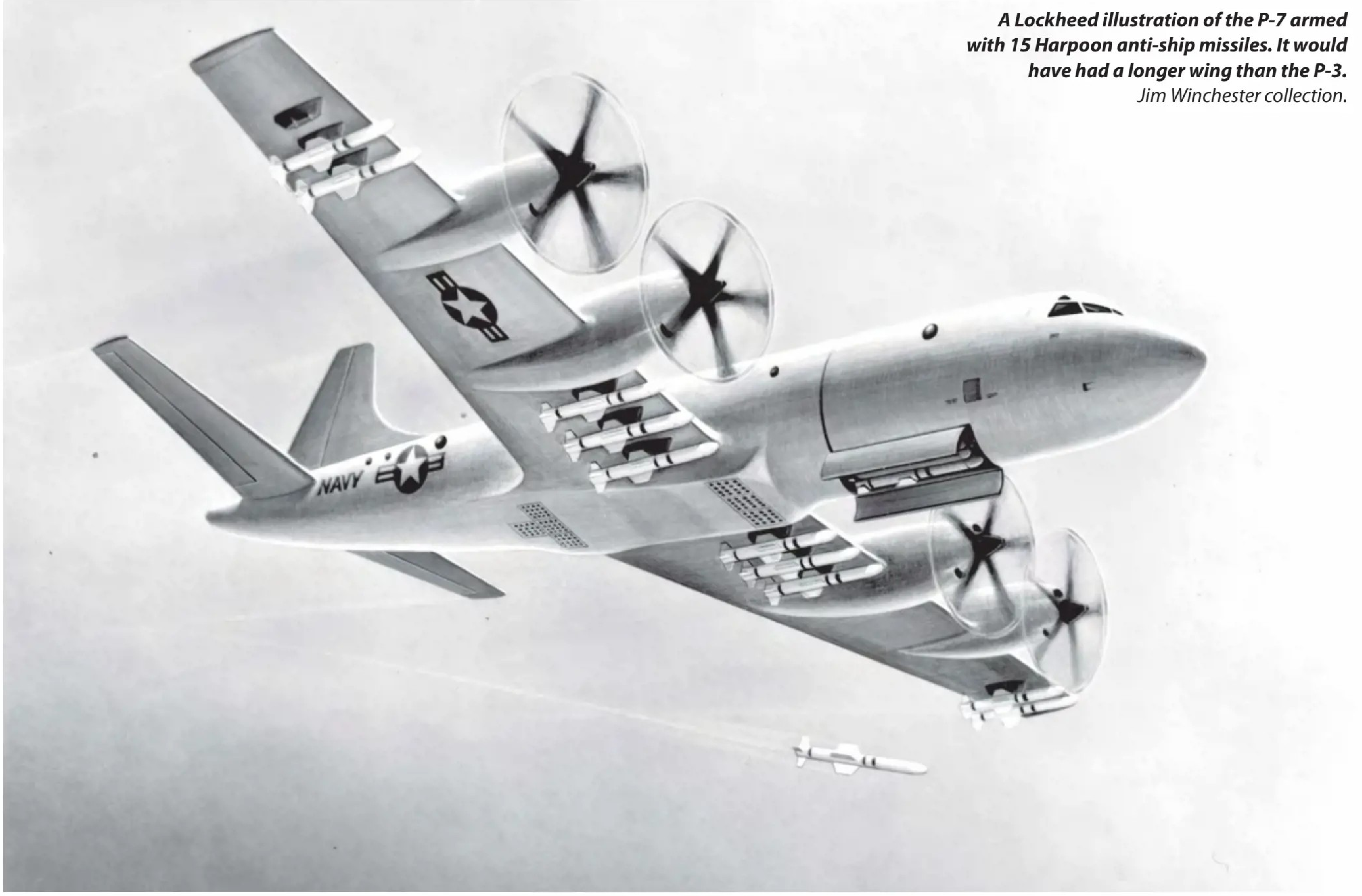
The winglet-equipped C295W has been sold in SAR and surveillance configurations. After 14 years of evaluation, Canada selected the C295W for its Fixed-Wing Search and Rescue Program (FWSAR) requirement in December 2016 to replace the CC-115 Buffalo. The first of 16 CC-295 Kingfishers arrived in September 2020 at 19 Wing, Comox where the type is operated by No. 442 Transport and Rescue Squadron.

Saudi Arabia's Ministry of Interior operates four C295Ws in the surveillance role, and Brazil's three SAR aircraft are designated SC-105. Chile's Navy ordered three C295s, the first of which was delivered in 2009 in MPA configuration in 2009. The next two are equipped with MAD booms for anti-submarine warfare.

PK-XNC was the first CN235-100 and served as a testbed for the MPA version, which was offered with either a standard nose or an extended nose housing a choice of surveillance radars.

Airbus CC-295 Kingfisher

Crew:	Two pilots, one flight engineer and two SAR technicians
Length:	70ft 2in (21.40m)
Wingspan:	84ft 8in (25.81m)
Height:	28ft 5in (8.70m)
Empty weight:	n/k
Max T/O weight:	51,150 lb (23,200 kg)
Powerplants:	Two Pratt and Whitney Canada PW127G turboshaft engines rated at 2,645shp (1,972 kW) Max speed: 298mph (480km/h)
Service ceiling:	25,000ft (7,620m)
Range:	2,300 NM (4,260 km)
Armament:	None



A Lockheed illustration of the P-7 armed with 15 Harpoon anti-ship missiles. It would have had a longer wing than the P-3. *Jim Winchester collection.*

Unbuilt Projects

MPA Might-Have Beens

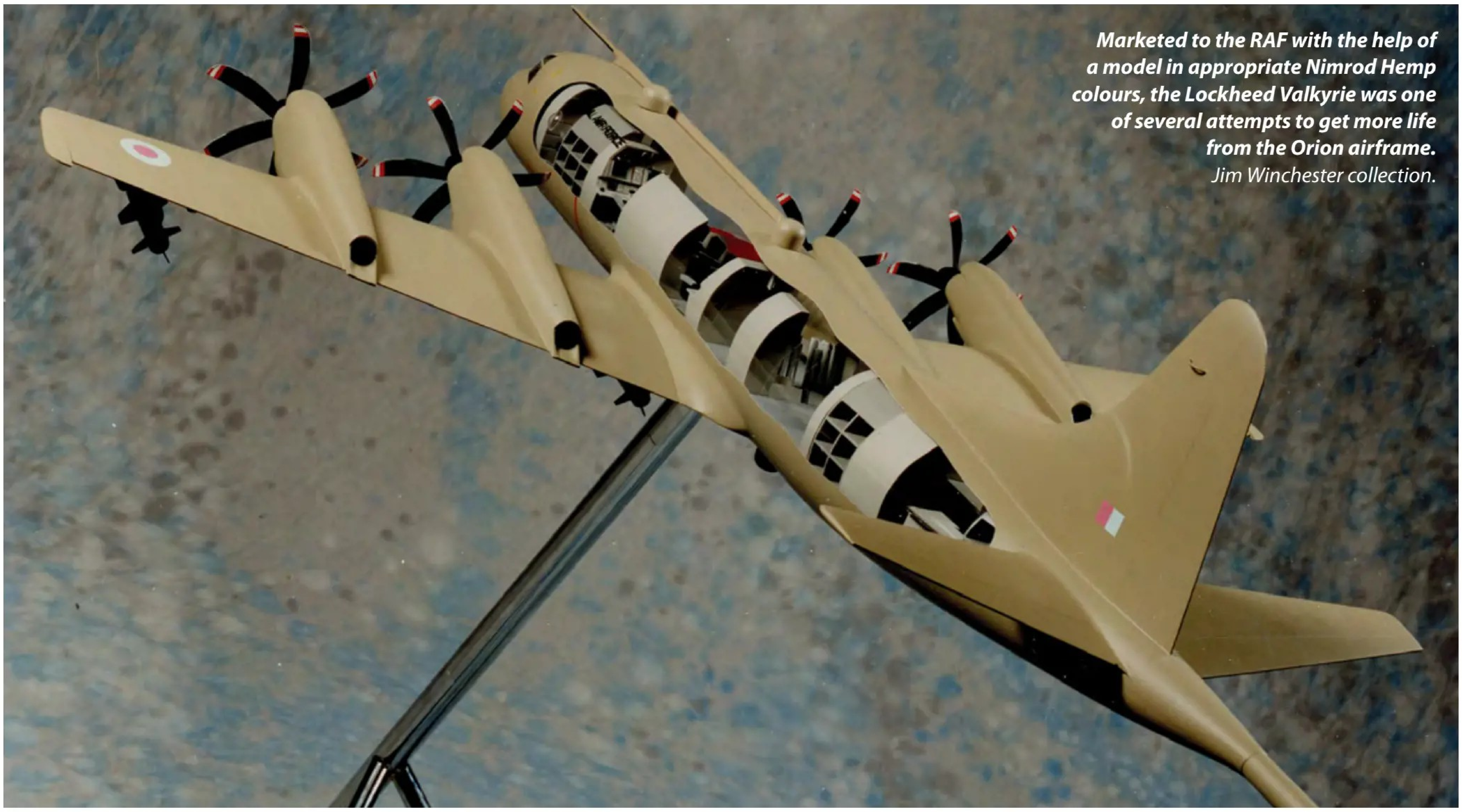
As with every class of aircraft, there are proposals that go no further than the drawing board. The airframe is perhaps the least important part of an MPA, which is why so many have been offered on the basis of commercial airliners and business jets.

Maritime patrol aircraft are costly beasts that need regular updating to stay relevant over decades of service. Their harsh operating environment, usually at low level over in salt-laden air means expensive maintenance. When it finally comes time to replace them, many solutions are offered.

One foreign Ministry of Defence official told the editor that the first phase of choosing a P-3 replacement once a request for proposals was issued was to eliminate the "Beam me up Scotty" responses that inevitably arrive. Once that is done, a business case must be presented to government for the choice of one solution over another. Do the users, which often include other government agencies such as fisheries ministries and intelligence services as well as Defence require or want a high-end MPA, a coastal patrol aircraft, or even an unmanned aerial vehicle (UAV), or a mix of these things? Once that has been narrowed down, what platforms on the market meet the requirement, and which of those is affordable, sustainable and interoperable with allied forces. Then the government will usually buy the cheapest option, or the most expensive, but not enough of them, or leave off certain capabilities with a vague aspiration of adding them later.

Anticipating a need for a P-3 and RCAF Argus replacement in the 1970s, the main airframe makers sketched some wild proposals, based on a shortened Lockheed TriStar, Boeing 720, Boeing 737 (with four engines) and Douglas DC-9, but serious efforts to replace or revitalise the Orion began in the late-1980s, when the US Navy launched the Long Range ASW-Capable Aircraft (LRAACA) programme. Boeing offered a 757 ASW derivative; McDonnell Douglas the P-9, based on the DC-9 with propfan engines; and Lockheed, a stretched P-3 powered by General Electric GE38 advanced turboprops. This latter was selected as the P-7A in October 1988, but soon ran into technical, cost and schedule difficulties. The contract was cancelled within a year, leaving the Orion to continue in USN service a further five decades and longer with other operators.

The basic idea of a new-generation P-3 was revived several times, including the P-3H Orion II with 6,000hp (4,476kW) engines, the Orion 2000 based on the P-3C airframe with P-7A mission systems, the Orion 21 using new or second-hand airframes, and the Valkyrie, proposed by Loral and E-Systems as a Nimrod replacement for the RAF using surplus P-3s. Dassault also offered an 'Atlantic 3' for this



Marketed to the RAF with the help of a model in appropriate Nimrod Hemp colours, the Lockheed Valkyrie was one of several attempts to get more life from the Orion airframe. *Jim Winchester collection.*

requirement, but the solution chosen was to rebuild Nimrods, scrap them and buy P-8s, but no missiles.

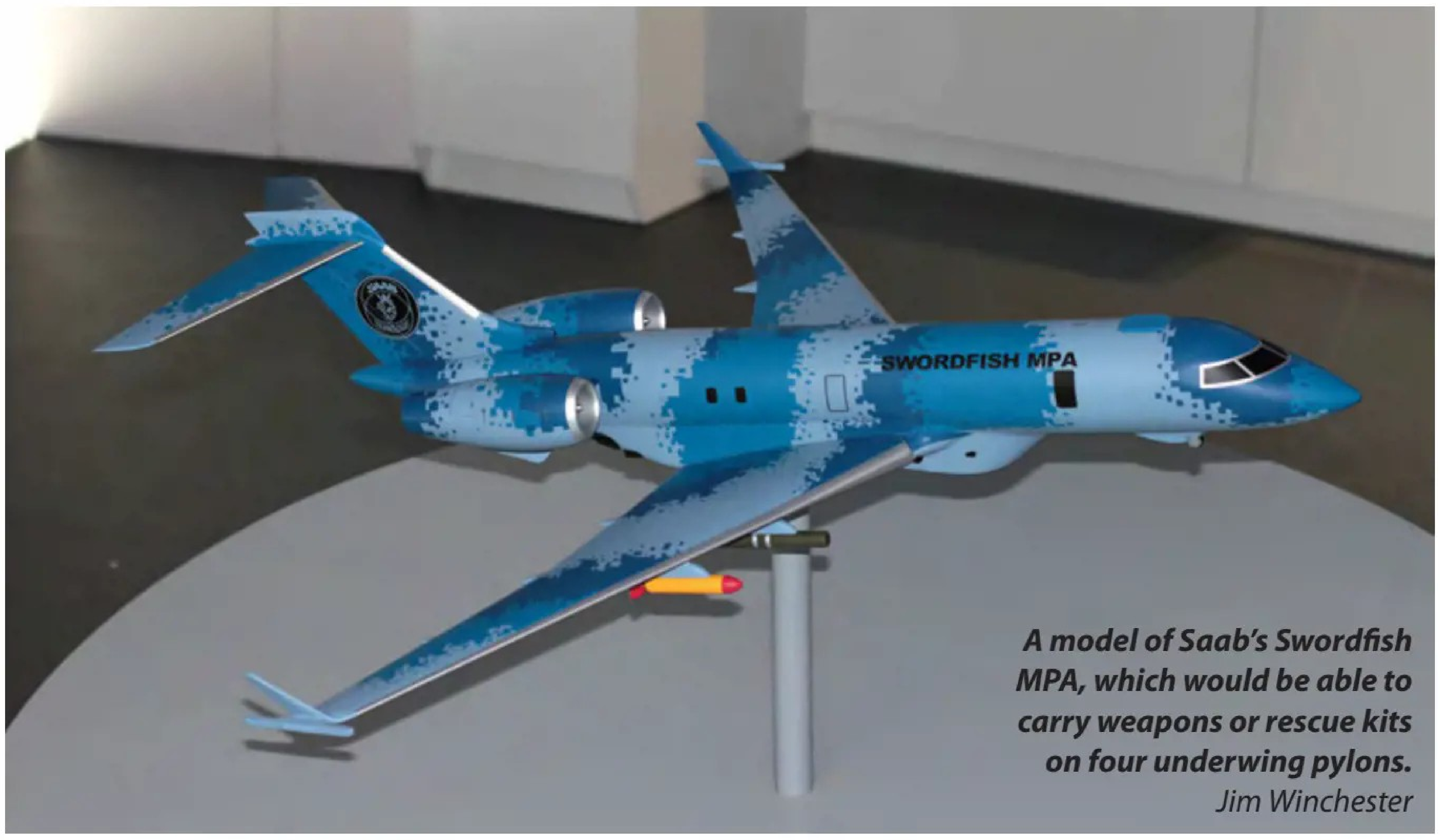
The Nimrod itself was chosen from a range of contenders including MPA versions of the Vickers VC-10 and Vanguard and the BAC-111. The decision was made largely on the basis of the consolidating British aircraft industry of the time and which manufacturer had the production capacity, but it worked fairly well in the end.

Many smaller MPAs have a mission crew of only two operators plus visual observers. The miniaturisation of processors and displays has replaced giant radar scopes and teleprinters with flat-screen displays and versions of instant messaging. This has allowed sophisticated mission kit to be "shoe-horned into biz jets" as one observer has put it. This has proved a harder sell on a competitive market, with Dassault having the only great success in this class with its Falcon family. The Canadair/Bombardier Challenger 604 is operated as a maritime surveillance aircraft by Denmark, but Boeing's attempts to sell a modernised MSA on a Challenger platform in the 2010s were unsuccessful.

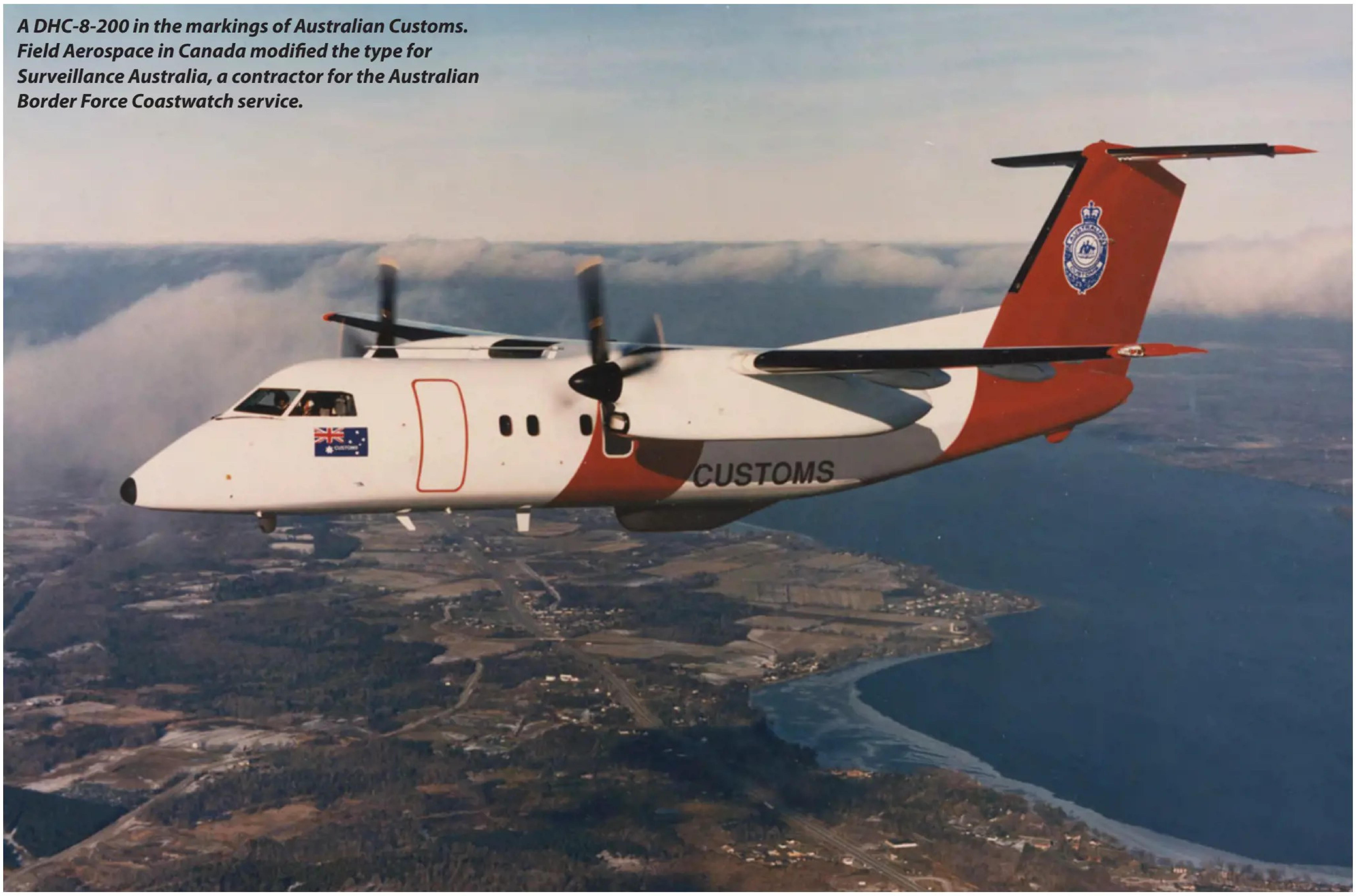
Sweden's Saab has successfully integrated AEW systems into its own Saab 340 and 2000 airframes, and into Global Express business jets as the Global Eye. Building on this, they proposed the Swordfish MPA, which would have been capable of patrol, ASW, anti-shipping and other missions. Advantages over larger platforms included a smaller logistical footprint and the ability to deploy without extra support for up to five days, limited only by the storage capacity for the prodigious amounts of data gathered by its sensors. Marketing efforts for the Swordfish were suspended in 2018, but could be revived.

Brazil's Embraer has offered an ASW version of the ERJ-145 commuter liner as the 145MP or P-99. The company has already created the special missions R-99 based on the same airframe, but has not yet flown a representative MPA version. The company has also marketed the C-390 Millennium airlifter as a SAR platform, using an externally-mounted targeting pod for search, and the rear ramp for life raft dropping. This configuration has not been adopted by any customers to date.

A version of the Airbus A321 seemed to be the preferred choice for the Franco-German Maritime Airborne Warfare System (MAWS) requirement, but with Berlin choosing the P-8 in late 2023, it remains to be seen if France can afford the development costs for an Atlantic replacement, or find enough partners and export customers to build an economically viable number of airframes.



A model of Saab's Swordfish MPA, which would be able to carry weapons or rescue kits on four underwing pylons. *Jim Winchester*



A DHC-8-200 in the markings of Australian Customs. Field Aerospace in Canada modified the type for Surveillance Australia, a contractor for the Australian Border Force Coastwatch service.

DHC/Bombardier DHC-8 MSAs

Twin-Turboprop Surveillance

Typifying the lighter end of the patrol aircraft market, the Dash-8 MSA is a small airliner outfitted with sensors and systems for maritime surveillance missions. Customers have included air forces, coast guards and customs agencies.

Other aircraft produced in this Maritime Surveillance Aircraft (MSA) category include the Bombardier Challenger 604, Dornier Do 228 and Saab 340. Normally unarmed, they have been used more in constabulary roles such as fisheries protection and pollution control than for high-end tasks such as anti-submarine warfare.

For more than five decades De Havilland Aircraft of Canada – previously Bombardier and before that De Havilland Canada – have produced the DHC-8, or Dash-8, or Q-Series turboprops for regional airlines and for government and military operators. The first Dash-8 (DHC-8-100) flew in June 1983. As a 40-seat commuter liner it sold well and was followed by the -200 with more powerful engines and the stretched -300 with 56 seats. In 1996, Bombardier became the sole owner of de Havilland Canada, and the aircraft were marketed as the Bombardier Q200 and Q300 (Q standing for quiet), with the stretched Q400 flying in 1998.

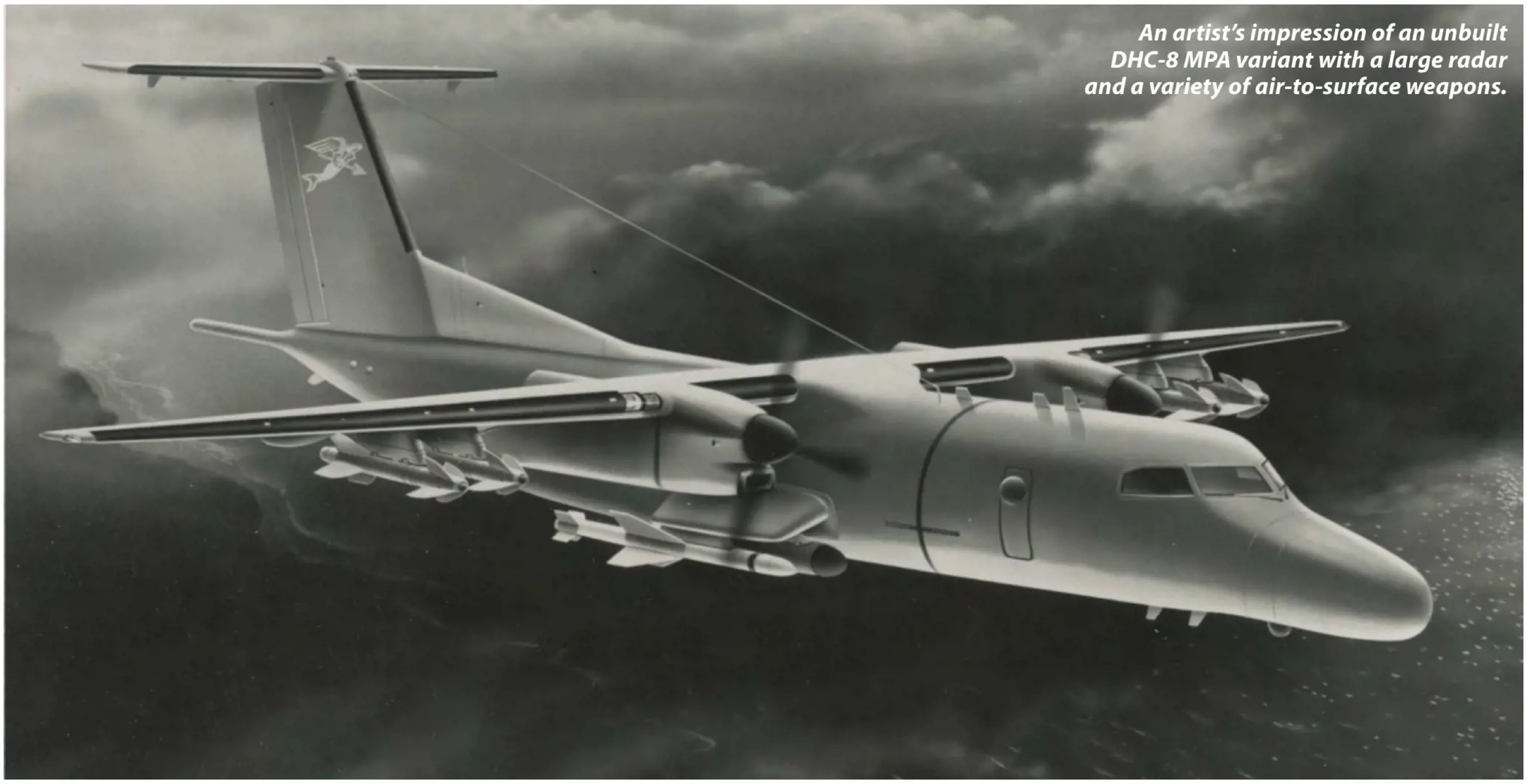
By this time, there were a number of MSA versions in service. Leader in modifying the type for surveillance use is Field Aerospace in Toronto, Canada has modified aircraft for several operators

They delivered three Q200s to Australia's Border Protection Command in 1995, later supplying three more and four Q300s. These were fitted with Raytheon SeaVue X-band radar and an MX-15 electro-optical sensor package. Like many MSAs, the operator's stations are standalone forward-facing units rather than mounted along one cabin wall. A ground proximity warning system (GPWS) is one of many other avionics additions, but this can be overridden to prevent constant alarms during low-level missions.

The United States Customs and Border Patrol (CBP) ordered seven Dash-8s (four -200s and three -300s) from Field, which were delivered between 2003-2009 with their configuration based largely on that of the Australian aircraft,

Dash-8-Q311 MSA

Crew:	Seven: two pilots, three systems operators and two observers
Length:	84ft 3in (25.68m)
Wingspan:	90ft 0in (27.43m)
Height:	24ft 7in (2.69m)
Empty weight:	26,042lb (11,812kg)
Max T/O weight:	41,301lb (18,643kg)
Powerplants:	Two Pratt & Whitney Canada PW 123 turboprops rated at 2,380hp (1,775kW)
Max speed:	330mph (532km/h)
Service ceiling:	25,000ft (6,720m)
Range:	1,063 miles (1,711km)
Armament:	None



An artist's impression of an unbuilt DHC-8 MPA variant with a large radar and a variety of air-to-surface weapons.

but with systems integrated by ATK's Mission Systems Group. The CBP aircraft can also be reconfigured as 37-seat utility aircraft.

The internal layout and role equipment is as varied as the operators. The Swedish Coast Guard (*Kustbevakningsflyget*) has three DHC-8-Q311s modified by Field and delivered in 2008. They have three identical operator consoles, dedicated observer stations with large conformal visual observation windows, provisions for a stretcher, and a four-person crew rest area with club seating. They have Elta EL/M-2022 radar, MX-15 and a Saab microwave SLAR, and have a liferaft dropping capability.

The Japan Coast Guard operates the Dash-8-300 as the Bombardier 300 Shimataka ('Island Hawk') Nine aircraft were delivered by Field in 2009-11, replacing the YS-11. They are equipped with surveillance radar and forward-looking infrared (FLIR) equipment for night operation. One was destroyed when it was struck by a landing Airbus A350 at Tokyo-Haneda in January 2024. The same aircraft had required extensive repairs after being caught in the 2011 tsunami.

Other MSAs based on the DHC-8 are operated by the Icelandic Coast Guard, Transport Canada and the UAE government. Deliveries of the first-generation DHC-8s (Q100, 200 and 300) ended in 2008, but a Q400-based platform was offered for the Canadian Multi-Mission Aircraft (CMMA) programme as the P-4. This competition was won by the Boeing P-8. At one time DHC proposed an MPA version with a large radar nose, a MAD boom and provision for underfuselage Exocet and Penguin missiles, but this was never built.

海上保安庁
JA722A

The Japan Coast Guard operated nine Q300 MSAs. Unfortunately, JA722A, named Mizunagi, was destroyed in a collision with a JAL A350 at Haneda Airport in January 2024. Jim Winchester

Three P-1s fly near Mt. Fuji in 2017. The type entered service from 2013 and by early 2025, more than 30 had been delivered to the JMSDF. *Japan MoD*

Kawasaki P-1

Big in Japan

The first purpose-designed maritime patrol aircraft to enter service since the Atlantic, the P-1 is one of the largest aircraft designed and built in Japan since the war and is optimised for low-level sub-hunting.

Project P-X began in 2001 for a four-jet MPA to replace the Lockheed/Kawasaki P-3 Orion in JMSDF service. Kawasaki Heavy Industries was awarded the contract to develop both the P-X and the C-X airlifter with maximum structural commonality. The two projects diverged and the C-2 shares only the windshields, outer wings and tailplane with the P-1. The XP-1 made its first flight at Kagamihara on 28 September 2007. Structural cracks found during testing of static test examples brought about some redesign and delayed service entry from 2011 to 26 March 2013 when the first two production aircraft were handed over to the JMSDF.

Operational testing was completed in September 2015 and full operational capability with 3 Kokutai at Atsugi was declared thereafter.

The P-1 is only slightly larger but considerably heavier than the P-3 and built to fulfil the same primary missions. Its speed and range figures up to 30% better than the Orion's. Like the P-3 it has a MAD tail boom, an undernose EO/IR turret and an ESM dome above the forward fuselage. All these items are of Japanese design and manufacture, including the engines.The primary sensor is a Toshiba HPS-106 surface-search X-band AESA radar with sub arrays in the nose, side cheeks and tail to give 360-degree coverage. Tucked away behind flush fitting undernose doors is a Fujitsu HAQ-2 EO/IR sensor, and in the tail 'stinger' is a Mitsubishi Electric HQS-102 magnetic anomaly detector (MAD). There is an electronic search measures (ESM) dome atop the forward fuselage and a satellite communications (Satcom) antenna further aft.

The cockpit has six colour MFDs, and HUDs for the two pilots, who use traditional yoke flying controls rather than sidesticks. Very large cockpit windows and jumpseats for observers aid in visual searches. A unique feature of the P-1 is its 'fly-by-light' (FBL) control system, which uses fibre-optic lines rather than electrical wires to transmit pilot inputs from cockpit to control surfaces. The P-1 is the first production

After testing, the XP-1 prototype was redesignated UP-1. *JMSDF*

aircraft to use FBL, although it has been tested on aircraft including the Gulfstream G 650 and Eurocopter EC 135. The advantages of FBL include greater speed and better resistance to electromagnetic interference.

The mission crew sit at four consoles along the port forward part of the cabin, each with dual colour displays. The TACCOs have forward-facing seats on either side by the bubble windows behind the cockpit. At the rear of the cabin there are observation seats at the windows, two forward-facing seats for the technicians on the starboard side and there is a crew rest area with four club seats and a table on the port side. A feature of the P-1 is artificial intelligence built in to the HYQ-3 Advanced Combat Direction System (ACDS), which processes sensor information and presents it to the TACCO with guidance as to his next actions, reducing decision time.

The P-1 can carry a variety of weapons on four underwing pylons and in a bomb bay forward of the wing, Weapons cleared for the P-1 include the AGM-84 Harpoon and Mitsubishi Type 93 (ASM-2) anti-ship missiles, the AGM-65 Maverick, the Mark 46 and Type 97 torpedoes, depth charges and mines. There are 37 Honeywell sonobuoy launch tubes in a panel behind the wing, again a configuration similar to the P-3 (which has 52 launch tubes in a similar position).

The P-1's four IHI high-bypass ratio two-spool turbofans with reverse thrust are unique to the P-1. Unlike the P-3, the P-1 does not shut down one engine for longer endurance, but runs all four at reduced power. The turbofans give a higher dash speed, allowing more time on station and reportedly the P-1 can fly more slowly than the P-3, aiding in visual search.

In 2015 the Japanese government approved a rare multiyear buy, ordering 20 P-1s for 350.4 billion yen (£1.825 billion). The stated JMSDF requirement was for 70 P-1s to replace the existing Kawasaki-built P-3C Orions, but in 2023 this was revised down to 61 airframes. In 2024 it was revealed that an electronic warfare variant was being developed to replace Japan's EP-3s. Wind tunnel tests have also been done on a P-1 model fitted with an AWACS-style rotodome.

Having relaxed its weapons export restrictions, Tokyo has made some effort to sell the P-1 to foreign nations, exhibiting it at the Royal International Air Tattoo and the Paris and ILA Berlin air shows, but there have been no overseas sales to date. The 2015 P-1 unit cost for the JMSDF was 17.52bn Yen (then £91.24m). In comparison, the unit flyaway cost of a P-8A was US$171.57m (£110.87m). Australia's eight P-8s

The large flight deck windows of the P-1 give an exceptional view to the pilots and observers. Note the large Head Up Display screens. *Japan MoD*

A P-1 drops self-protection flares during the 2015 International Fleet Review off Tokyo. *Jim Winchester*

were bought for AUD$4bn or (then) £234.88m each, including the all-important support contract and some weapons.

P-1s were visiting New Zealand as part of the Royal New Zealand Navy's 75th anniversary celebrations in November 2016 when an earthquake struck Kaikōura. They assisted in damage assessment missions alongside RNZAF and USN P-3s.

Despite its relative newness, Japan has already begun studies to replace the P-1 with a future fixed-wing MPA. Kawasaki instituted a project team in April 2023 anticipating deployment of the P-1's successor with the JMSDF in the 2040s.

One of two P-1s that flew around the world in July 2015 lands in Djibouti where exercises were held with JMSDF anti-piracy units. *Japan MoD*

Kawasaki P-1

Crew: 11-13: Normally two pilots, a flight engineer, two Tactical Coordination Officers (TACCOs), four mission crew and two in-flight technicians/ordnancemen

Length: 124ft 8in (38.0m)

Wingspan: 116ft 2in (35.4m)

Height: 39ft 9in (12.1m)

Empty weight: n/k

Max T/O weight: 175,705lb (79,700kg)

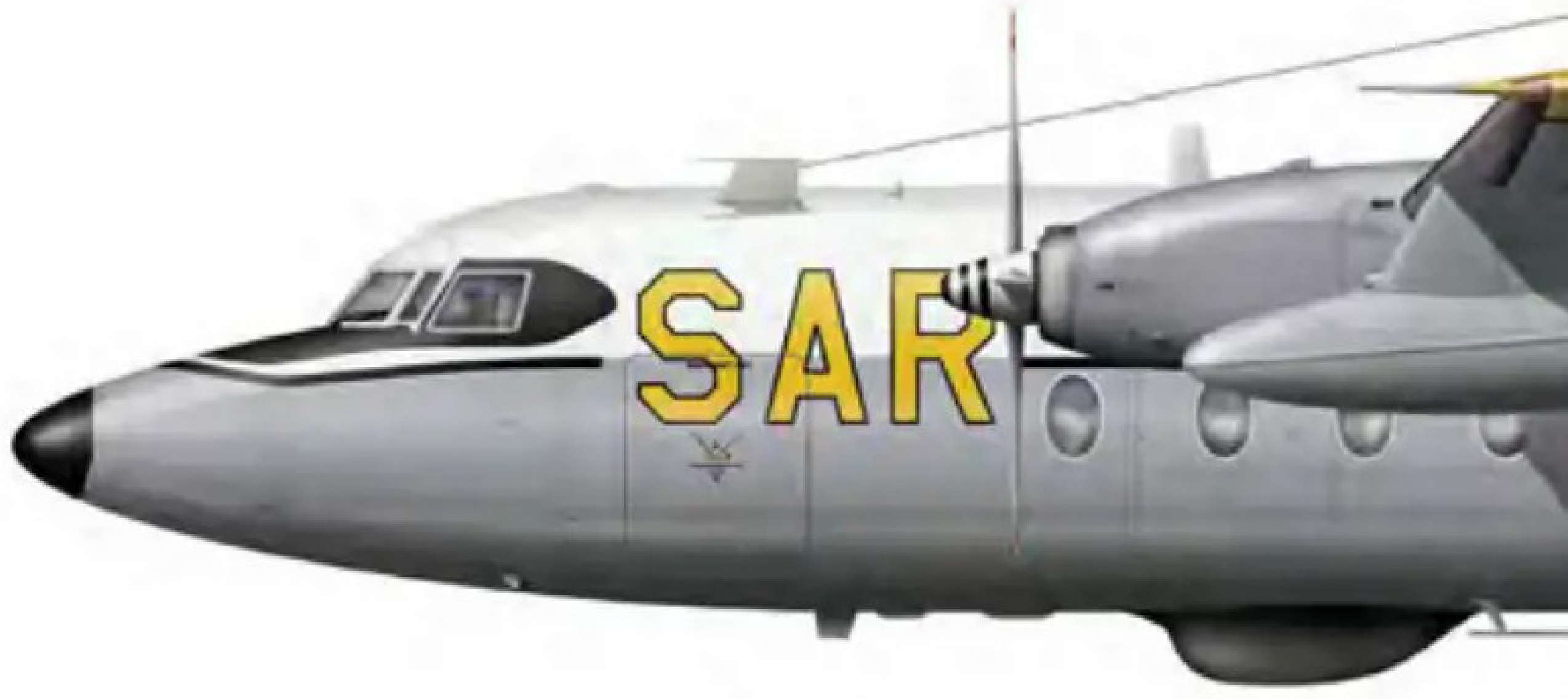
Powerplants: Four Ishikawajima-Harima F7-10 turbofans rated at 13,448 lb (59.8kN) static thrust

Max speed: 619 mph (996km/h)

Service ceiling: 44,356ft (13,520m)

Range: 4,971 miles (8,000km)

Armament: Max payload of 16,000lb (7,257kg) including AGM-84 Harpoon, Mitsubishi Type 93 (ASM-2) and AGM-65 Maverick missiles, Mk. 46 and Type 97 torpedoes, depth charges and mines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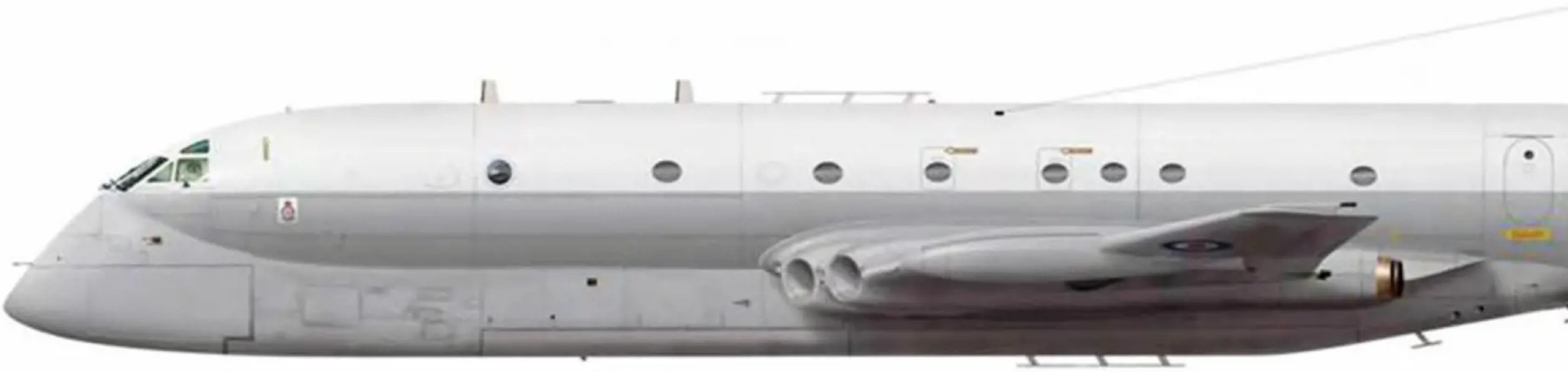

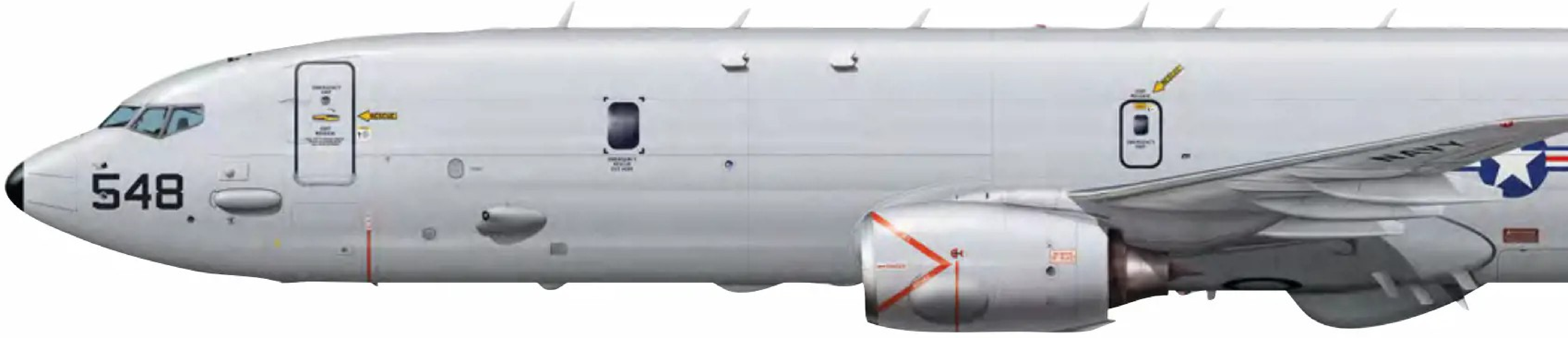
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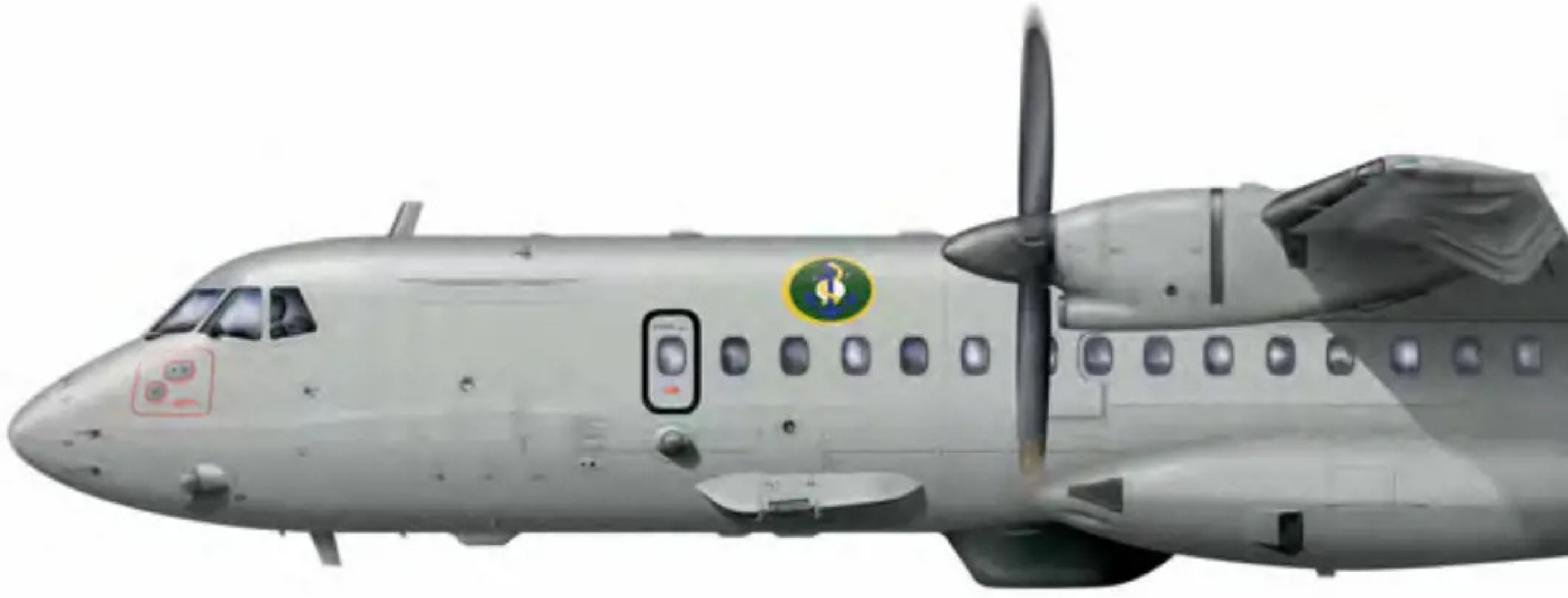
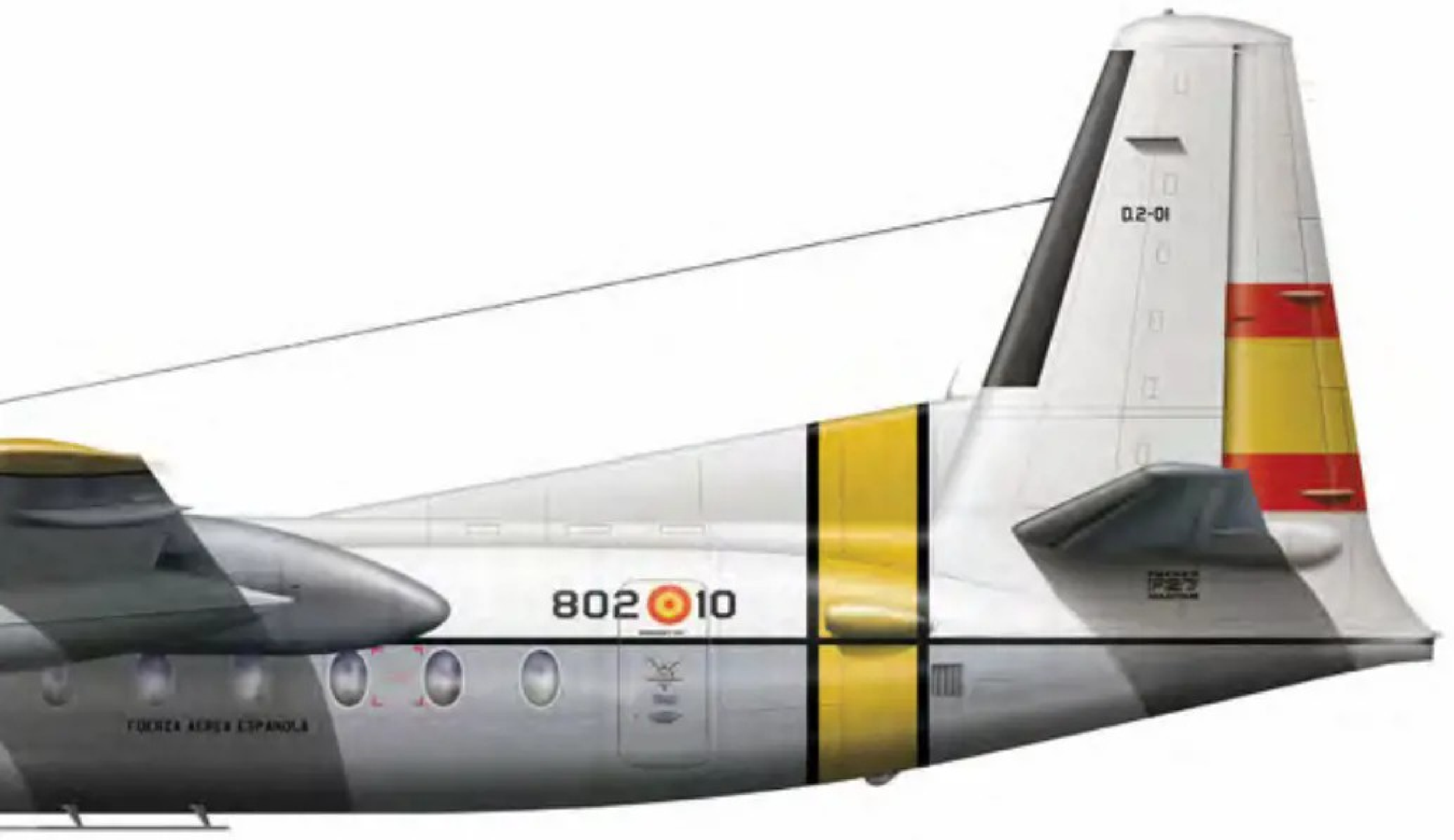
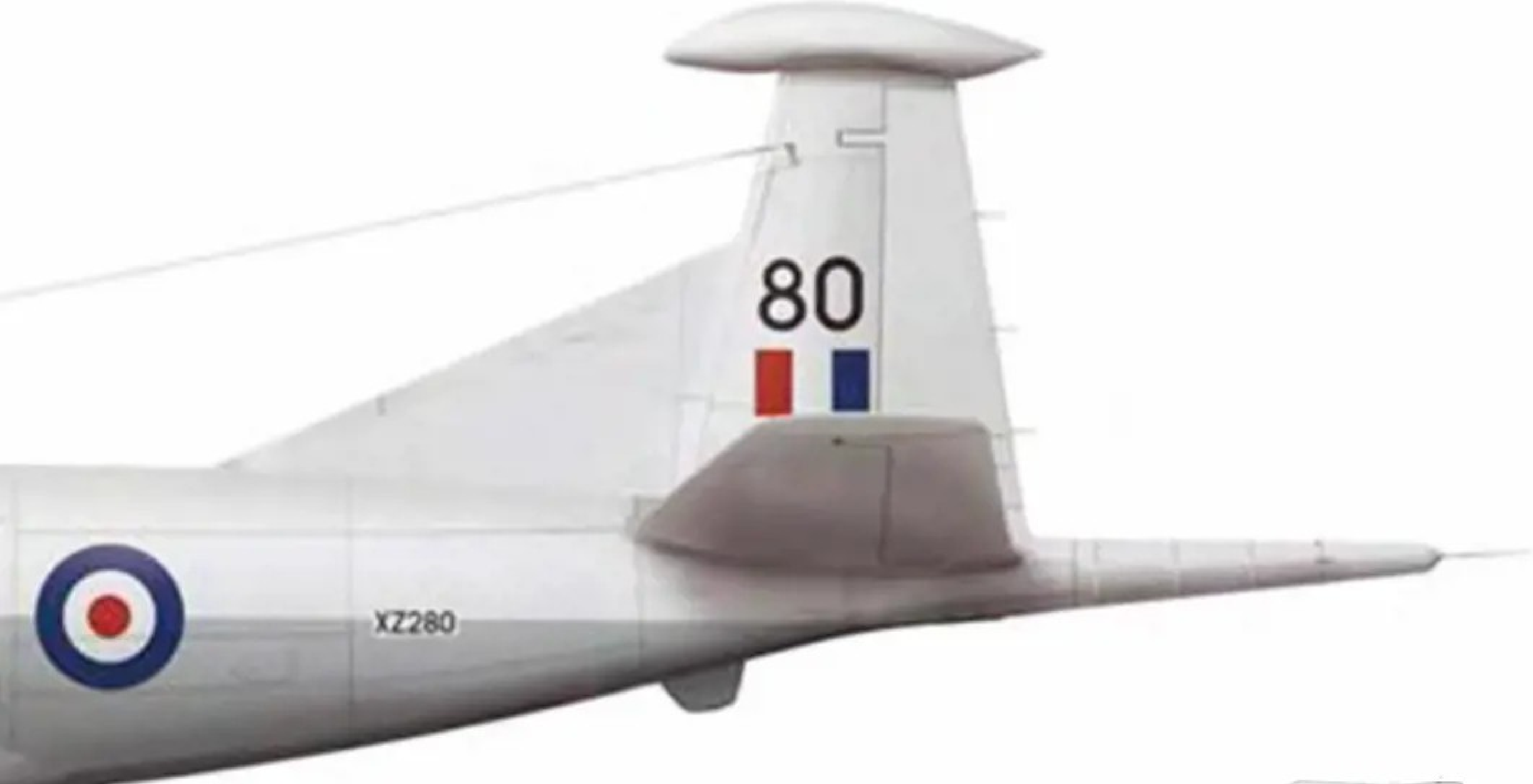




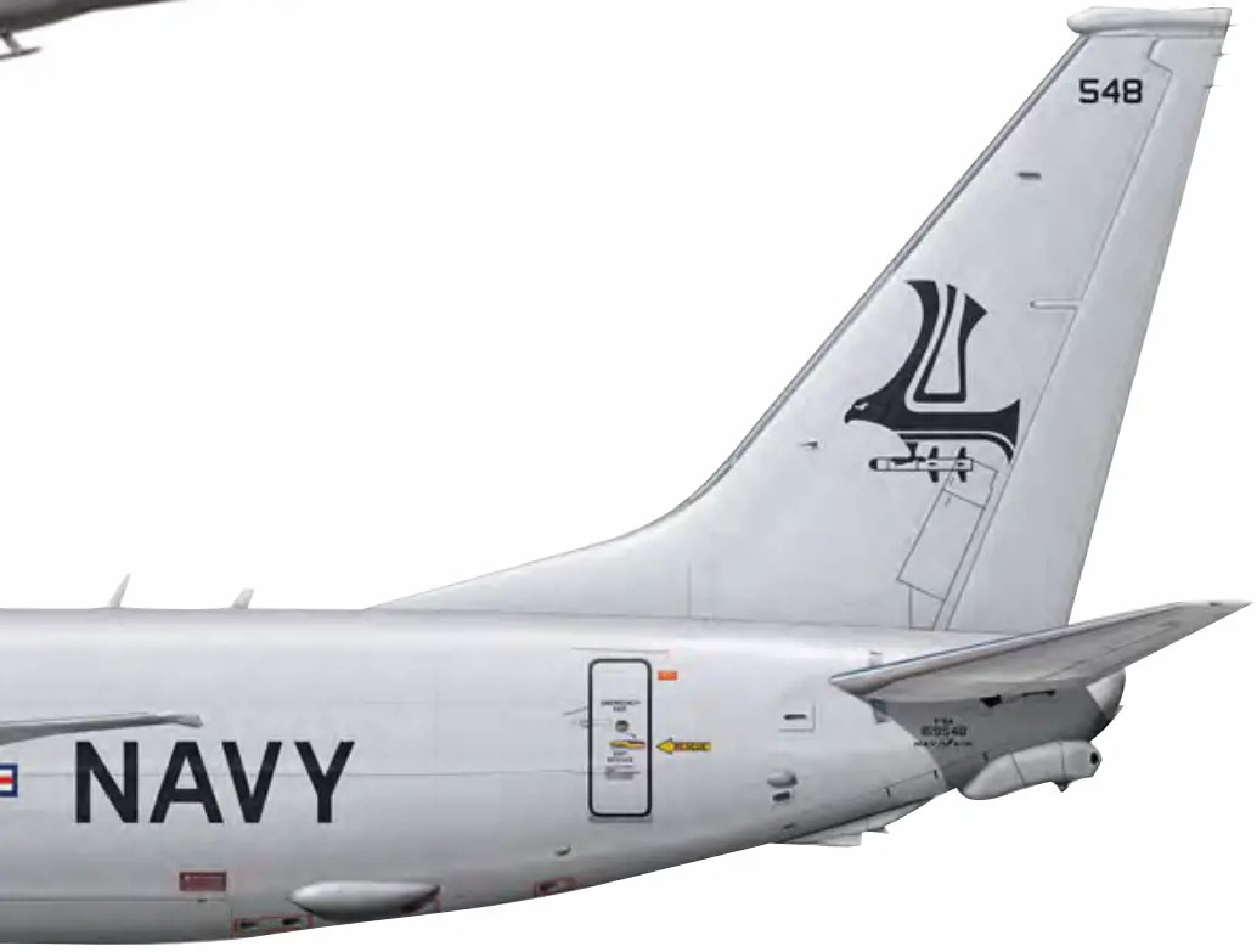
Fokker F27-200MAR Maritime
D.2-01, C/N 10581
Esc 802, Spanish Air Force
Gando, Canary Islands

After test-flying in November 1978 with test registration PH-EXA, the first F27-200MAR was leased to the Spanish Air Force for training and proving flights using the registration PH-FTK. In January 1979 it returned to Fokker for fitting out with maritime reconnaissance equipment. One of three of the type in Ejército del Aire service, D.2-01 later wore an overall grey scheme with yellow bands. Based in the Canary Islands for SAR duties, it was withdrawn from use at Gando by 2013 and more recently stored outdoors at Cuatro Vientos. In 2024 it was repainted for display at the Museum of Aeronautics and Astronautics.



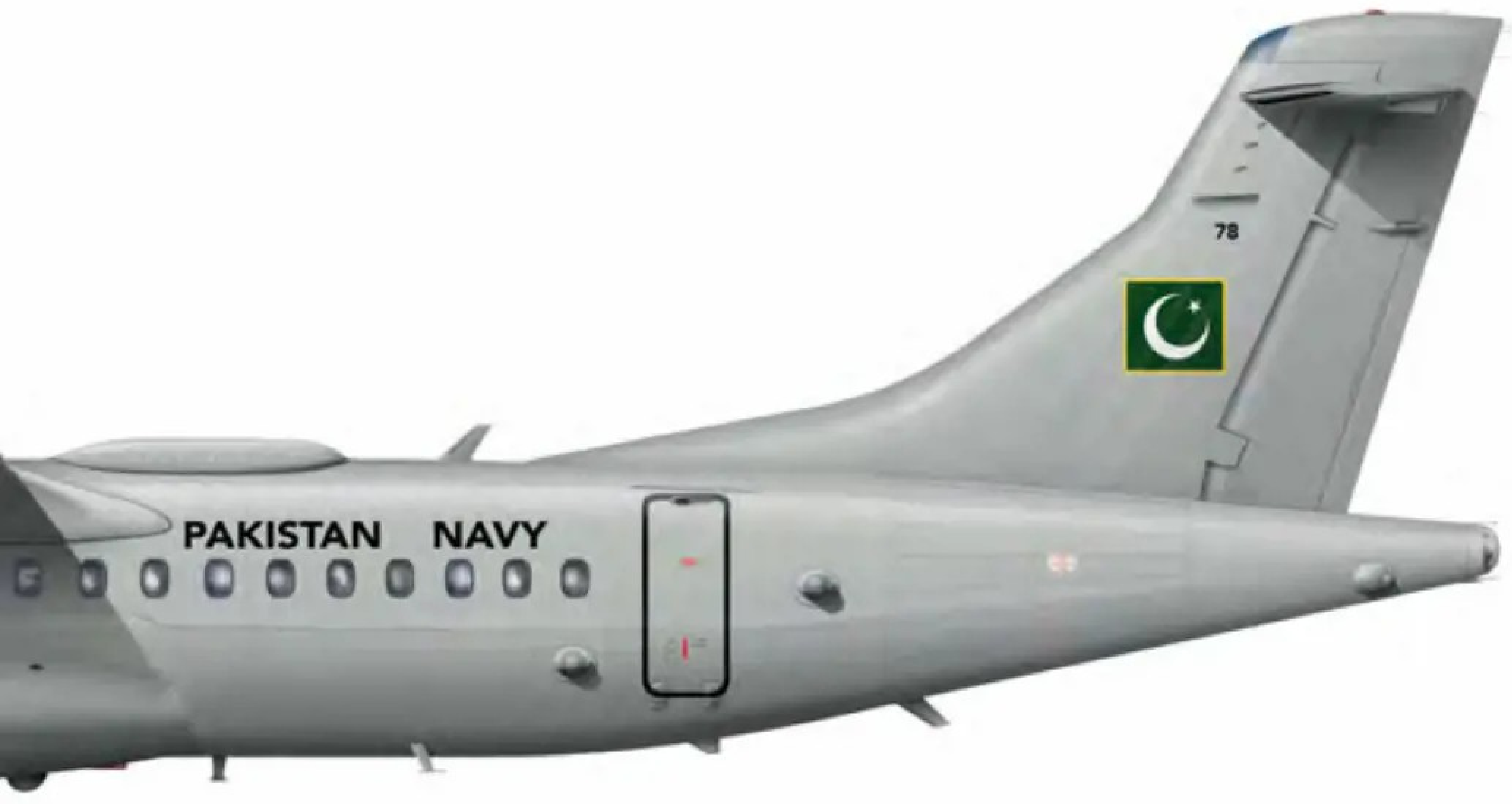
Hawker Siddeley Nimrod MR.1
XZ280, C/N 8042
No.18 (Maritime) Group,
RAF Kinloss, Morayshire
1975

XZ280 was the first of of a second batch of six Nimrod MR.1s ordered in February 1972 to bring squadrons up to strength. It was delivered to RAF Kinloss, Morayshire on 7 April 1975 where it was operated in a pool arrangement by Nos. 120, 201 and 206 Squadrons. It was selected for conversion to AEW.3 standard and flown to BAe Woodford, Cheshire in March 1981. By mid-1986 it was on loan to the Ministry of Defence Procurement Executive, or MOD(PE), but the Nimrod AEW programme eventually failed and XZ280 was broken up at Abingdon, Oxfordshire in April 1992.



Boeing P-8A Poseidon
Bu. No. 169548
C/n 64078
VP-9, NAS Whidbey Island, Washington, 2021

P-8A 169548 was delivered in February 2019 to VP-1 'Screaming Eagles' at Whidbey Island, Washington. By 2021 it was with VP-9 'Golden Eagles' at the same base, and made lengthy deployments to RAF Lossiemouth, Scotland and NAS Sigonella, Italy that year. As depicted, '548' wears the squadron insignia of an eagle carrying a missile rather than the unit's tail code of 'PD'. Another shift of squadron was to VP-45 'Pelicans', based at NAS Jacksonville, Florida, in which markings it appeared at the ILA Air Show at Berlin-Brandenburg, Germany in June 2024.



RAS-72 Sea Eagle
78, C/N 712
No. 29 Squadron, Pakistan Navy
PNS Mehran, Karachi

This aircraft was built in 2004 as an ATR72-500 airliner for Binter Airlines and operated with the Spanish registration EC-JAH and Binter Canarias branding. It was delivered to Pakistan in August 2013 and initially used as a military transport. It was noted in Monchengladbach, Germany in 2018, where Rheinland Air Service GmbH converted it to Sea Eagle maritime patrol configuration. It re-appeared in June 2019 with the serial 78 and was ferried to Karachi via Italy, Turkey and Saudi Arabia. It serves alongside two other RAS-72s and two ATR-500 transports with No. 29 ASW/EW/IW Squadron of the Pakistan Navy.

Boeing P-8 Poseidon

Lord of the Sea

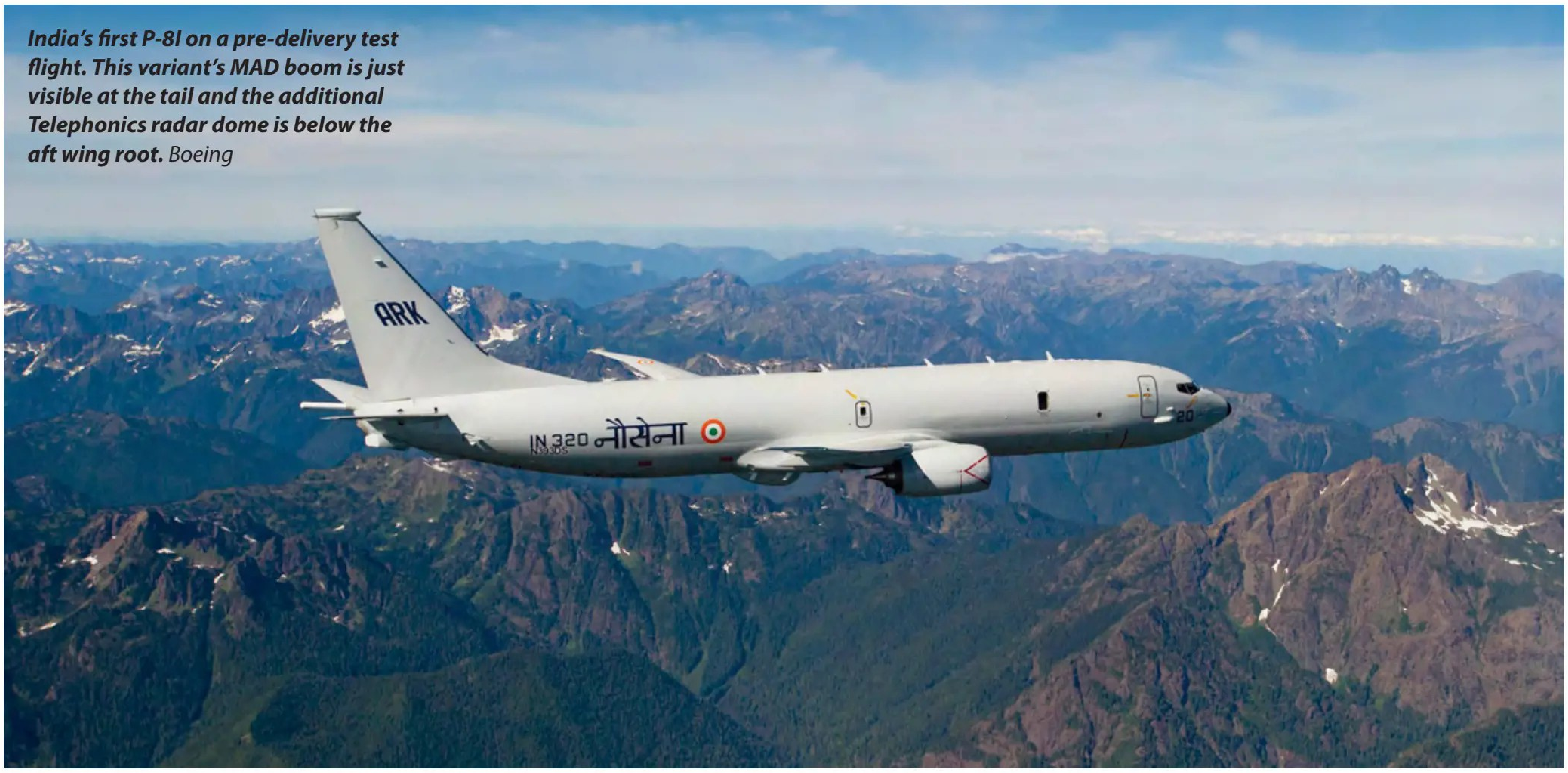
The P-8 has become the de facto replacement for the USN's Orions and for those of many other operators, plus Nimrods, Atlantics, *Mays* and *Bears*.

In the early 1980s, Boeing had created a maritime patrol version of the 737-200 airliner, the Surveiller. It featured side-looking radar with long antenna fairings at the base of the tail and was only purchased by Indonesia. Otherwise, the 737 was not usually considered as the basis of a patrol aircraft.

Following the cancellation of the the Long Range Air Anti-submarine Warfare (ASW) Capable Aircraft (LRAACA) programme and the Lockheed P-7 in 1989, P-3 operators carried on upgrading their Orions until a new search for a P-3 replacement was launched, the Multi-Mission Aircraft (MMA) programme, in 2000. Lockheed offered a new-build 'Orion 21', but it was Boeing with a militarised version of the 737-800IGW airliner that won the competition in 2004. The first flight of the P-8A

The P-8 is much more than a 737 with some ASW gear stuffed inside. This VP-4 Poseidon was en route to an overland surveillance mission in Afghanistan in May 2021. *Senior Airman Taylor Crul, USN*

The seagull badge of No. 11 Squadron RAAF now flies on the tail of the P-8, after many years gracing the AP-3C Orion. FLT LT Andrew Gill, RAAF.
Jim Winchester


India's first P-8I on a pre-delivery test flight. This variant's MAD boom is just visible at the tail and the additional Telephonics radar dome is below the aft wing root. *Boeing*

Poseidon followed on 25 April 2009 at Renton, Washington.

Production of the USN Poseidon began in March 2011, and the first example was delivered to VP-30 at NAS Jacksonville, Florida a year later, with the US Navy announced initial operating capability on November 29, 2013. Poseidons have progressively replaced P-3 Orions in the regular patrol squadrons, now serving with Fleet squadrons VP- 1, VP-4, VP-9, VP-40 and VP-47 of Patrol and Reconnaissance Wing Ten (PATWING 10) at NAS Whidbey Island, Washington and VP-5, VP-8, VP-10, VP-16, VP-26, VP-30 and VP-45 of PATWING 11 at NAS Jacksonville, Florida P-8s also fly with Reserve squadron VP-62 and special projects unit VPU-2 at Jacksonville, Reserve squadron VP-69 at Whidbey Island and test unit VX-1 at Patuxent River, Maryland.

The P-8 is based on the Boeing 737-800 fuselage, albeit substantially modified to include a weapons bay, and with increased electrical generation capacity. This is married to 737-900 wings with hard points. The airframe has structural strengthening for military operations. Despite its lineage from an airliner designed to cruise at 30,000ft (9,144m), crews say its a delight to fly at 250ft (76m) the traditional altitude for submarine hunting using magnetic anomaly detection. Only one operator to date has specified a MAD system in their P-8s, and ASW missions are mainly conducted at medium levels. Although it has overall less endurance than the P-3, the higher dash speed and more efficient cruising altitude allows it to reach the patrol area faster and spend more time on station.

The Poseidon's comprehensive mission system features an APY-10 radar with modes for high-resolution mapping, an acoustic sensor system, including passive and multi-static sonobuoys, a retractable electro-optical/IR turret and electronic support measures (ESM). A total of 129 sonobuoys can be dispensed from rotary launchers, and a variety of life rafts and survival packages can be dropped.

Poseidon MRA.1 ZP808 bashes the Lossiemouth circuit in March 2021. *Jim Winchester*

Norway's fleet of P-8As will operate in the dark and cold of winter and under the midnight sun of summer. The first Poseidon for 333 Squadron arrived at Evenes in February 2022.
Philip P. Linder, Forsvaret

ROYAL NORWEGIAN AIR FORCE
9583
9583

The aircraft's mission systems are fully digital, allowing wide area surveillance and enhanced network connectivity with other air, land and naval assets. With trained and experienced operators the sensor suite is able to narrow down a submarine contact to the type and even the individual hull.

The USN has installed the Raytheon APS-154 Littoral Surveillance Radar System on a handful of its aircraft to give them a wide-area overland capability, similar to that on the USAF's Northrop Grumman E-8 JSTARS or the RAF Raytheon Sentinel R1.

The Indian Navy was the first and is the largest international customer for the P-8. Until the order for eight on January 2009, India's military had not operated a Boeing aircraft, nor was it a P-3 user, having fielded a fleet of Soviet-made Il-38 and Tu-142 MPAs. The first P-8I flew in September 2011, and deliveries began in 2013 to INAS 312 at INS Rajali, Tamil Nadu.

A option for four more was taken up in 2016 and a further six were ordered in late 2019. The P-8I differs from the P-8A most notably in having a MAD boom in the tail and an additional Telephonics APS-143 OceanEye radar under the fuselage.

In July 2007 Canberra announced the P-8A as the preferred replacement for the RAAF's AP-3C Orions, ordering eight in 2014 and a further four in 2016. The first arrived to join No. 11 Squadron at RAAF Edinburgh, South Australia in November that year and all were delivered by November 2019.

The first RAF Poseidon MRA.1 for the RAF flew in July 2019 and was delivered in February 2020 to Kinloss Barracks, the former RAF Kinloss, which was being used as a 'bolthole' while runway resurfacing was undertaken at Lossiemouth. It was soon at work, observing the passage of a Russian Navy corvette through the English Channel and then assisting the Home Office in monitoring small boats carrying irregular migrants.

The return of a dedicated MPA came after a ten-year 'capability gap' which opened when the Nimrod MRA.4 was abandoned and the Nimrod MR.1 fleet retired in March 2010. In the interim, the RAF had done its best to prevent aircrew attrition and corporate skill fade by running Project Seedcorn, which saw personnel posted to units in the USN, RAAF, RCAF and RNZAF over a number of years. This drew down from January 2019 when the first 38 personnel of No. 120 Squaron arrived at NAS Jacksonville, Florida to begin operational conversion training to operate the P-8A. The first three Poseidons flew from Kinloss before moving to Lossiemouth and being joined by the remaining six. A second squadron, No. 201, reformed in August 2021 and acts as the Poseidon Operational Conversion Unit (OCU) as well as having a front line role.

Initially, the only RAF weapon was the Mk. 54 lightweight torpedo, but integration of the British Sting Ray Mod 1 torpedo began in 2023. This weapon is designed to defeat both fast, deep diving double-hulled submarines operating in the deep ocean and quiet, conventional submarine in coastal waters.

Under the New Zealand MOD's Future Air Surveillance Capability (FASC) project, various solutions were considered to replace and enhance the country's maritime patrol fleet, including the Kawasaki P-1, Saab Swordfish and a proposed SC-130J Sea Hercules. The P-8 was chosen for its interoperability with allies, supportability and upgradability over the long term. Four aircraft were purchased, the last arriving in July 2023.

The larger and heavier aircraft required a move from the traditional home base of Whenuapai, Auckland, to Ohakea, in a more rural location with longer runways. The P-8s are multirole, with duties including long-range SAR, fisheries patrol, maritime domain awareness, humanitarian assistance and disaster relief and pollution monitoring. The only weapons currently employed are Mk. 54 torpedoes. To complement the P-8s for lower-end inshore patrol, the RNZAF modified two of its four Beech 350 King Airs with surveillance radar and cameras.

In 2024, an RNZAF P-8 was deployed to South Korea to help enforce sanctions against the North, observing vessels of interest and suspected ship-to-ship transfers of banned goods such as oil.

The first of five P-8As for the Royal Norwegian Air Force flew in August 2021. As with New Zealand, the new aircraft require more facilities and longer runways, and the decision was made to move the MPA unit to Evenes and close Andøya. This was partly reversed in 2024 and Andøya will stay open to operate long-range surveillance drones of a yet-to-be-determined type. Norway is cooperating with the UK to share some maintenance and simulator facilities at RAF Lossiemouth.

Two future customers are Germany, which ordered five P-8As in 2019 for delivery in 2025, and Canada, which ordered 14 plus two options in 2023 for 2026-28 delivery. Static tests of the P-8's airframe have verified its structural integrity to more than double its 30-year initial design life. Combined with a planned upgrade cycle, the Poseidon should remain operational for many decades to come.

An Italian Air Force-operated ATR P-72A patrols the Mediterranean from its home base at Signoella. *Leonardo, Luca La Cavera*

ATR 42 and 72 Patrol Variants

Maritime Patrol Airliner

The ATR high-wing turboprops have carved out a niche in the MPA sector for air forces that can't afford or don't require the largest and most sophisticated platforms.

The ATR (*Avions de Transport Régional/Aerei da Transporto Regionale*) partnership began in February 1982 with Aérospatiale (now Airbus) and Aeritalia (now Leonardo) each having a 50:50 share. The first 48-seat ATR 42 flew on 16 August 1984 and the stretched 70-seat ATR 72 followed on 27 October 1988. The company's only current products are the ATR 42-600 and ATR 72-600 regional airliners and freighter and patrol derivatives thereof.

Launch customer for the ATR 42MP Surveyor was Italy's Guardia di Finanza (financial police), which accepted three examples, one each in 1999, 2002 and 2005. They are used for coastal patrol and vessel identification and tracking as part of anti-smuggling efforts. The Italian Coast Guard (*Guardia Costiera*) acquired two ATR 42MP-400s and one -500 airframes in 2002-03. They ordered an additional -600 aircraft equipped with the ATOS (Airborne Tactical Observation and Surveillance System) mission suite in November 2024. The Libyan Arab Air Force ordered one ATR 42MP for maritime patrol duties in January 2008, but this does not appear to have been delivered before the 2011 Revolution. Nigeria has two 42-500MPs in operation with 107 Air Maritime Group at Benin.

ATR 42MPs are equipped with a multi-mode radar, an electro-optical sensor turret with colour and monochrome cameras, an Automatic Identification System (AIS), a Direction Finder (DF) and video recording equipment. There are two bubble windows and two external pylons on the forward fuselage, which can mount a high-intensity searchlight or other equipment, including gunpods. Mission endurance is about 7hrs.

With 10hrs endurance and greater internal space, the ATR 72 has also proved popular as a maritime patrol aircraft, usually with a more sophisticated sensor suite and with

Leonardo P-72A

Crew:	Two pilots and four systems operators
Length:	89ft 2in (27.17m)
Wingspan:	88ft 9in (27.05m)
Height:	25ft 10 (7.72m)
Empty weight:	32,156lb (14,586kg)
Max T/O weight:	50,706lb (23,000kg)
Powerplants:	Two Pratt & Whitney PW127M turboprops, each rated at 2,750hp (2,051kW)
Max speed:	289mph (465km/h)
Service ceiling:	25,000ft (7,620m)
Max endurance:	10hr at 5,000ft (1,524m)
Armament:	Two light torpedoes or depth charges on underwing pylons; two torpedoes or missiles on under fuselage hard points

Three ATR 42-420MPs are active with the **Guardia Costiera**. ***This one is assigned to 3°*** **Nucleo Aereo** ***at Pescara. Note the pylon-mounted searchlight.*** *Leonardo*

10-02
GUARDIA COSTIERA

weapons capabilities. Prime contractor for the P-72 is Leonardo Aircraft Division, which is responsible for integrating the mission and defensive avionics, that includes a Seaspray 7300E electronically-scanned array search radar and Elettronica self-defence suite. The ATOS suite requires only two operators, owing to its sophisticated data fusion. The Airborne Search And Rescue System Direction Finder (ASARS DF) has been useful in tracking irregular migration across the Mediterranean. The P-72A has been called on many times to deploy liferafts at the location of sinking boats. Under the Meltem III project banner, Turkey has also ordered a version of the ATR 72 as the Turkish Maritime Patrol Aircraft (TMPA) using the Thales AMASCOS (Airborne Maritime Situation & Control System) mission suite. The first flew in 2013 and was handed over to Turkish Aerospace Industries for completion, although deliveries of mission-capable aircraft did not begin until 2021. Two simpler C-72 TMUA (Turkish Maritime Utility Aircraft) variants entered service in 2013 and serve with No. 301 Filo.

Deliveries of P-72As to the Aeronautica Militare's 41 Stormo at Sigonella, Sicily, began in November 2016 and the type officially replaced Italy's Dassault Atlantics as of September 2017. The fourth and last P-72A for the Italian Air Force was delivered in August 2019. P-72A weapons include Exocet anti-ship missiles, A-2445 torpedoes and Mk. 11 depth charges.

The P-72B is a variant without weapons capability. Four were delivered to the Guardia di Finanza by July 2022. It uses the ATOS system to locate and identify sensitive targets, monitor their behaviour, obtain evidence, and guide the intervention of naval units and ground patrol teams.

In May 2023 Malaysia ordered two ATR 72MPAs for delivery in 2026. The designation 'P-72M' has been mentioned, although may not be official. The configuration is expected to be very close to that of the Italian aircraft. Reportedly Nigeria has two ATR 72s on order.

A related aircraft is the ATR 72 conversion by Germany's Rheinland Air Service as the RAS Sea Eagle MPA. The first customer was the Pakistan Navy, who received the first of two in mid-2018, The conversion includes the Aerodata AeroMission Mission Management System, an AESA surveillance radar system, two weapon hard points, a sonobuoy launching system, a broadband satcom system and an Electronic Support Measures Systems as well as a high-resolution electro-optical and infrared system.

Not all ATR patrol variants are created by Leonardo. One of two RAS Sea Eagles for the Pakistan Navy was displayed at the 2019 Paris Air Show. *Jim Winchester*

PAKISTAN NAVY

NEXT ISSUE!

US Airlifters

Cargo and transport aircraft or 'Trash Haulers' do not always attract much attention, but the range of types and used by the United States and the variety of missions they perform is staggering. 'C-Planes' deliver troops, vehicles and equipment to the battlefield – sometimes without landing – carry VIPs and staff officers, conduct Special Forces missions, gather intelligence and even provide fire support to troops on the ground. In future they are being considered as stand-off 'missile trucks' and communications relay platforms.

From the C-47 Dakota to the VC-25 'Air Force One', *Aviation Archive* Issue 79 will look at all these roles and the wide range of aircraft that have carried them out, using historic photographs, detailed cutaway drawings and beautiful colour profile illustrations.

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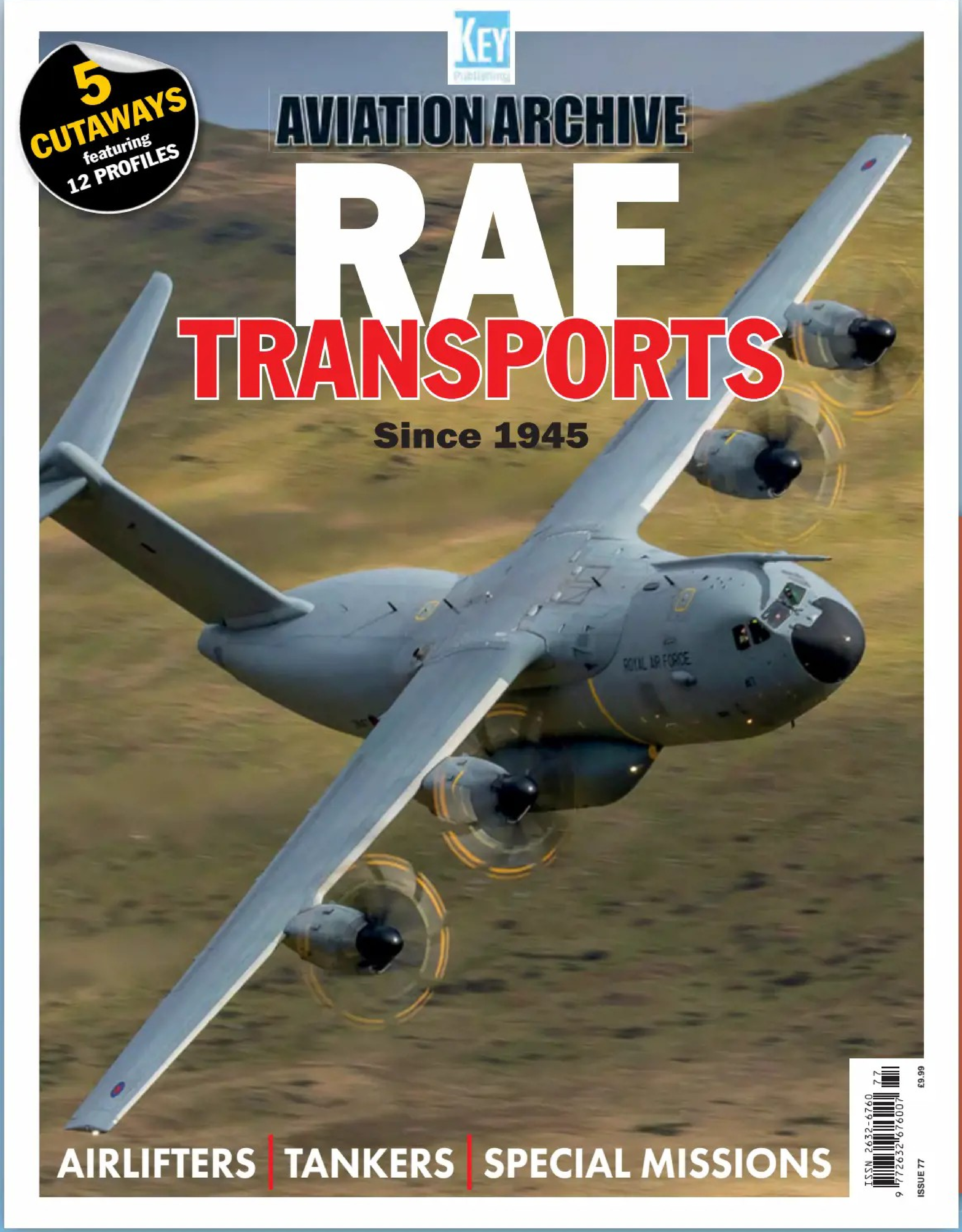
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